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Engineering News-Record

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Sanitation in China

Wind on Tall Buildings

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Railway Engineering Convention Report

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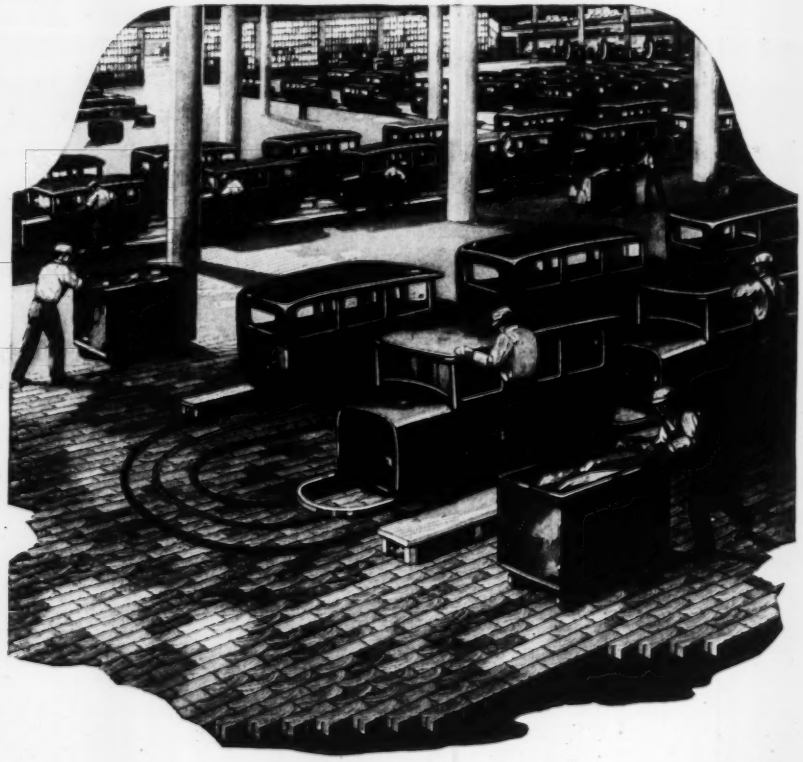

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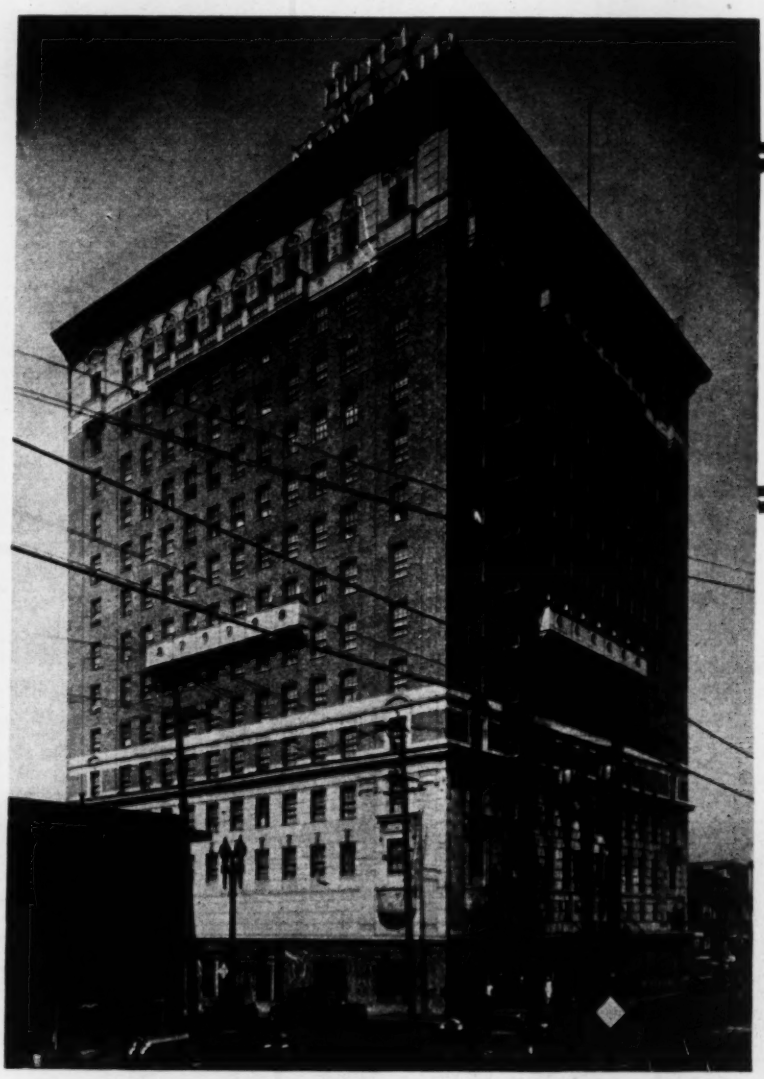

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 104 NEW YORK, MARCH 20, 1930 Number 12

Construction Fires

A DISASTROUS fire last week in the falsework centering of the Boundary Creek channel spans of the Arlington memorial bridge again emphasizes the potential danger from fires which exists on almost every construction job. Rarely is construction plant equipped with ample fire protection to offset the fire hazard. Forms, falsework and temporary works of all kinds are largely built of soft wood, and in addition the vast amount of trash and debris of all sorts which accumulates on every job constitutes a potential mass of fuel for a damaging fire. In winter construction the necessary use of open salamanders and canvas protection adds another element of risk. The hazard arising from all these conditions can be greatly reduced by providing adequate, but not necessarily elaborate, fire-fighting equipment, by keeping the work free of trash, and by establishing an efficient watchman service. The Arlington bridge fire repeats a useful warning to contractors.

Landing-Field Maintenance

OIL-TREATED landing strips at some airports have been found to develop growths of weeds and grass. Such growths are not unknown in road practice, and the aviation industry is thus merely learning anew that oiled surfacing is not a permanent improvement to be forgotten when once placed. Experience with similar surface-mixed oiled materials in highway practice has revealed that the oil does not remain on the surface, but continually tends to work down, resulting in the depletion of the top wearing layer. Weeds naturally grow as soon as the soil becomes free enough of oil content. The remedy is periodical application of more oil. This also will prevent the formation of cracks and ruts that cut through the surface and permit the entrance of water. While subdrainage may avoid the worst results of such seepage, a more economical precaution is maintenance by disking, dragging and rolling, similar to the original processing. Landing strip maintenance has many other points of similarity to highway maintenance, and the fund of information accumulated through years of experience in the older field can be applied easily and profitably to the younger.

Better Public Speaking

THAT the engineer needs to be well versed in the art of presenting his case before an audience would seem to be self-evident in these days of radio broadcasting, financial drives and reporting to city councils. Even the young engineer in presenting an idea to his squad boss in the drafting room needs to be skilled in marshaling his ideas if he would be convincing. With a view to fostering public speaking by the engineer the educational committee of the Associated Technical Societies of Detroit has assisted in forming an intercollegiate engineering debating society. Seventy engineering students at the University of Michigan debate or "wrangle" once a week, under competent guidance. Debates have been held with other institutions. In addition to the engineering students at Michigan those at Detroit Institute of Technology, Northwestern, Michigan State College, Ohio State University and Purdue University have become interested in the movement looking toward a tournament of debates on engineering subjects. No form of campus activity will net better results to the participants. Listening to engineering society presentations may yet become a pleasure.

Governmental Engineering Service

ATTEMPTS to extend governmental functions outside the sphere of government are always with us. There is now in Congress, for example, a bill which would put the United States government into the business of furnishing consulting highway service to foreign governments. A similar bill introduced in the last session did not pass, but another attempt is to be made. The bill would authorize the President at the request of governments of North, Central and South America or of Cuba, Haiti and Santo Domingo to detail engineers of the Bureau of Public Roads to assist them in highway matters; such advisory service is to be paid for by the countries in question, but the engineers are also to continue receiving their regular compensation. The proposal plainly contemplates activities unrelated to the task of governing the United States. Engineering consultation is the recognized field of private activity, and since ample engineering ability is available for the purpose in question there is no emergency which might serve as reason for injecting the government into the field. The bill should be killed.

New Rail Study

CONTINUATION of a discouragingly high rate of rail failures has spurred rail manufacturers and users into a new attempt to determine why so many rails fail in service. For years rails have been subjected to study as to their physical properties and their reaction to service conditions, and generally attempts have been made to correlate the two. So far, however, the results have been inconclusive because of limited knowledge of one or more of the factors and because it seldom has been possible to concentrate the study of all factors upon rails from the same mill and heat. Last week the American Railway Engineering Association gave its approval to a proposal to make such a study upon a large scale. The association's rail committee, co-operating with a similar committee of manufacturers, has outlined a program calling

for the rolling of about 5,000 tons of rail under carefully controlled conditions. About 90 per cent of the rail will be put in service in locations where its condition can be studied continuously, and the remainder will be set aside for laboratory study. Thus, for the first time, it will be possible to carry on concurrent studies of large quantities of rail from the same mill and the same heats both in service in the track and in the laboratory. Not only will it be possible under these conditions to make exhaustive studies of the physical and chemical composition of the rail as it goes into the track but it will be possible also to have sufficient of the new rail from the same heats always available for comparison with the used rail as physical changes occur in that rail in service. This study is expected to cost $50,000 a year and to extend over at least five years. The A.R.E.A. has asked the American Railway Association, of which it is a member, to contribute half the cost of the first year's operations. The rail manufacturers' committee has undertaken to raise a like amount among the mill owners. It is to be hoped that both parties to the project will support it liberally. No one subject in railway work presents as many baffling problems as does rail, and none holds as many possibilities for increased safety and economy.

Unworked Sanitary Fields

HOW vast and nearly unworked fields there are for sanitary engineering in by far the larger part of the world is realized by few unless they have read or traveled widely. Outside North America, parts of South America, all of Great Britain and perhaps a half dozen of the countries of continental Europe, only a beginning here and there has been made in providing public water supplies, sewerage, refuse and garbage disposal and protection against the spread of communicable diseases by flies, mosquitoes and rodents. In none of these vast areas and among none of these huge national aggregations is sanitation more lacking than in China. An outline of conditions in that country has been drawn by an engineer who is devoting some months to a sanitary reconnaisance of several countries of the world, beginning with the Far East. This week's article on China will be followed at intervals by outlines of conditions in several other parts of the world. Japan, a land of strong contrasts to China, will be taken up next. Later on the sanitary stage will be contracted to give a picture of accomplishments in Manila.

Tolls on Public Works

SHALL public toll works be continued as revenue producers after the users have paid off their total cost? The question emerges from the contest which surrounds the proposed new highway tunnel under the Hudson River. Two states are involved, and two interstate administrative boards; the states are not agreed on the proper method of managing the enterprise, and the two boards propose radically different plans and still more sharply divergent methods of jurisdiction and financing. It is an interesting contest and one whose decision should lie with the public.

At the time the Holland tunnel was undertaken it was promised and universally believed that tolls would cease or would be reduced to running-cost basis as soon as the first cost had been refunded. But for this promise and understanding the undertaking would probably never have been authorized. In New Jersey, where a referendum vote was taken to authorize bonds (New York contributed its share of the tunnel cost from current income), the voting public quite generally believed that the stipulations carried an implied promise to wipe out or reduce tolls as soon as the cost was repaid. Less directly the New York public received a similar understanding. Repayment is likely to be complete in seven years more. Now the proposal is made to continue tolls after that time and use them to pay for the midtown tunnel. It represents a distinct and we think a serious breach of faith with the toll-payer. The first duty of government is to keep faith with the public.

Both the Tunnel Commission and the Port Authority propose this continuance of tolls. They have a color of justification in the fact that the tunnels parallel each other (about 4 miles apart) and so tend to be competitive; it is claimed that enough tolls could not be collected at the midtown tunnel if the Holland tunnel at that time were toll-free or had greatly lower rates. The fact is that the distance between makes them not appreciably competitive for their proper tributary traffic, since anything over 5 miles of detour would wipe out the saving of the toll (average 55c. per vehicle). The same reasoning applies to the further proposal that after 1943 the revenue of both tunnels should be used for building additional highway tunnels; in so far as they are competitive the argument may be advanced that tolls on the older ones must continue—though we believe the argument is fallacious.

The Port Authority further proposes that the four bridges which it has built or is building, which also connect New York with New Jersey, be grouped together, and the Holland tunnel and midtown tunnel added thereto, all in the Port Authority's jurisdiction; that their income be pooled, and that this total be used as the backing of bonds to be issued by the Port Authority for building the midtown tunnel or other crossings. At present the income of the two Arthur Kill bridges is in pledge to support one bond issue—that which built them—and the Hudson River bridge income is similarly pledged to its own bonds, which have no other security; the same is true of the Kill van Kull bridge.

At present, therefore, each structure stands on its own revenue credit, and cannot be built if that credit is not strong enough. This is an obvious requirement of sound procedure. It is completely destroyed in the proposed pooling of properties, which thus opens the door to misjudgment or even manipulation. Perhaps safeguards could be devised as partial control on such tendencies. But safeguards are not needed; they would have no value except as they limit each bond unit to its own income unit, and this is the very thing which the new attempt plans to avoid.

The toll-refunding system of public-works financing is only a few years old, too short a time for all its virtues and defects to develop. It is a useful tool, but not without its dangers. One of these is the possibility that a permanent toll impost may become fastened on the public, leading to double or multiple repayment and all the reckless spending of public funds which excess of easy revenue entrains. The tunnel proposals make this possibility a real thing to reckon with. They should be scotched at all hazards. Better to have no second tunnel than to have it on such unsound basis.

Reservoirs for the Mississippi

SIX weeks ago an event occurred which is certain to exert momentous influence on the future course of the Mississippi River flood-control project. That event was the victory of residents in the Boeuf basin in their suit against government officials asking stoppage of work on the floodway until provision shall have been made to pay them for their land. The outcome of the suit virtually overthrew the entire official flood-control plan; it cannot be carried out until Congress passes new legislation. At this time, therefore, certain possibilities which were rejected in the hurried formulation of the project two and a half years ago again come up for attention. Reservoir storage is the most significant of these.

To understand fully the effects of Judge Dawkins' decision in the suit mentioned it should be observed that his interpretation of the case renders impossible the construction of the adopted project within the limit of expenditure ($325,000,000) authorized by the act of May 15, 1928. Floodway easements, which now must be bought, had been ignored in making the estimates for the project. Apparently, by some curious operation of the Washington mind, the government officials had assumed that without asking leave they could inclose private lands by flood-channel levees and expose peaceable citizens to frequent risk of being swept away by torrents of floodwaters. The court says that this may not be done without buying out the owners' rights—an obvious matter of elementary justice. To do so, however, will require added expenditure of a hundred million or two that was not reckoned in the estimate or in the Congressional authorization. Since, therefore, the mandate of the present law to build the specified works for 325 million dollars is not capable of being carried out, it may well be that all further expenditures on the flood-control works are unlawful. But so far as we know the question has not actually been raised, and Congress is expected to amend the law during the coming summer.

Through these developments a new balance sheet of costs and benefits has been set up for the Mississippi project and the whole aspect of the problem changed. Wide, uncleared floodways may not be economical, now that land must be bought, though two years ago a rough-and-ready judgment preferred them to narrow floodways. Detention of flood peaks on tributaries may have much greater possibilities than it was then credited with, and the subject merits more careful investigation than by the superficial reconnaissance of that time.

Some figures computed by the well-known Louisiana river engineer J. P. Kemper give a point of departure for thoughts on the possible utilization of storage. Mr. Kemper has found that in the region between the Arkansas and Red rivers the flood flow above the safe capacity of the future channel is a relatively small fraction of the total, and he concludes that this surplus flow can very possibly be held back in storage reservoirs. His figures and conclusions are highly suggestive. It would be unfair to consider them as more than this, for they involve a number of obviously important questions: on size of maximum flood in terms of surplus volume, on location and cost of suitable storage, and on the practicability of operating reservoirs so that they will be effective at all times. Moreover, even Mr. Kemper's limtited estimate of surplus, twenty million acre-feet, is a huge volume. It is only little below the entire capacity of the proposed Boulder Canyon reservoir, the largest ever contemplated, and six or seven times the capacity of the Saluda reservoir. To impound the Mississippi's peak flow will take many reservoirs of great size, and headwater storage alone will not do. Yet the possibility of eliminating the diversion through the Tensas basin is important in money, in engineering and in human factors—too important to permit of leaving any stone unturned in the search for the right solution.

If the project is ever to stand on a thoroughly sound foundation it will be only when the benefits and costs have been measured fully for each of the several alternative possibilities of control. The economics of the project therefore merit exhaustive study, as we have urged in previous discussions. Present developments afford a brilliant opportunity for such study.

Numerous factors within the alluvial valley itself affect the problem, among them the utilization of the delta basins and the burden of marginal lands on the agricultural situation. But beyond these are considerations which affect larger areas of country and which have political as well as economic weight.

The streams embraced in the Mississippi system create trouble elsewhere than on the main river alone. Regulation of tributaries was a legislative issue even two years ago, but it was crowded out of the picture under administration pressure when the flood-control bill was being jammed through Congress. It is a much bigger issue today. The destructive powers of the unregulated tributaries loom as a weightier factor of the problem not only because these streams contribute to the valley floods but also because they are of prime concern to the farming states, whose interests have fared badly in recent legislative proceedings. Will Congress be inclined to provide some hundreds of millions more for the Mississippi project if the money is all to be spent along the main river? Probably not. Its members are more likely to favor an even larger expenditure on a project that spreads the benefits farther afield, as, for example, by control of floods on tributaries.

For more than one reason, therefore, the present situation of the project focuses prime attention on reservoir possibilities. Since the future course of the flood-control work will lay a burden of added dollars on every family purse in the entire country, there is reason for every citizen to take personal concern in the solution reached. In this light it is vital that the project be made so convincingly clear and sound in its technical and economic aspects as to assure it of universal support.

Restudy of the Mississippi flood-control plan is already under way. It is justified and made necessary not alone by the Boeuf decision but by the subsequent ban of prosecution of the Atchafalaya floodway work, by the high land payments adjudged in the condemnations for the New Madrid floodway, and by the continuing inadequacy of the protection given to Cairo—one of the grave danger points of the river system. It should by all means include exhaustive investigation of reservoir possibilities. We urge that it be made so thorough as to correct the fatal defects that have marked the project up to now and assure the maximum of benefit to the whole Mississippi basin as well as to the country at large.

Engineering in Five Kansas Counties

Two Articles Setting Forth Practices of Wide Applicability Found on a Recent Reconnaissance Into the State

By Waldo G. Bowman
Assistant Editor, Engineering News-Record

I—Practices of a Self-Sufficient Office and of One Employing a Consultant

IN APRIL of last year a new highway law went into effect in Kansas. Its main provision deprives the county governments of their ancient control of the state highways and places the system unequivocally in the hands of the state highway department. It is sure to have salutary effects on Kansas highway practice, giving the state needed opportunity to develop a connected and unified system. At the same time it has the indirect effect of raising the efficiency of county engineering, and this is the subject of present interest.

The new highway law brought the county engineers of the state face to face with a multitude of engineering problems which, although they had always been known to exist, were new in the sense that the county engineers previously had been forced to ignore them. By the relinquishment of control of the state system, under the new law, the county engineers passed on a burden that was taking all of their time and most of their money, to the detriment of the main county system, whose problems now become paramount. The state system had represented a very small percentage of any county engineer's total highway mileage, but it was important and, besides, money was available for it. With the passage of the new law, the county engineer was enabled to turn his attention to his major highway mileage and the new problems which it presented. Furthermore, his status as engineer of county affairs in general was improved, a circumstance of large possibility.

FIG. 1—COUNTY MAP OF KANSAS

Eastern quarter of state hilly with thickly wooded stream valleys. Prairie wheat belt commences in central section, continuing westward to flatter plains country near Colorado line. Streams flow east or southeast. Cross-hatched counties are considered in these articles.

With these developments in Kansas as a background, the writer recently made a reconnaissance of the state to determine the attitude of the county engineers toward their new status and to glean from them details of practices which might be applicable and helpful to county engineers elsewhere. Considerable time was spent in each of five counties. As a group, these counties are typical of Kansas counties, while individually they represent the extremes in topography in the state and reveal the wide scope of work which is the county engineer's.

It was immediately obvious that the county engineers were quite alive to their new responsibilities—welcomed them, in fact. They recognized their major problem as one of providing connecting roads to assist the largest possible number of people to reach the main state highways and of joining market centers where these were not already on state highways. They appreciated that a different type of road was required than had been built for the state and that less money was available to be spread over a greater mileage than under the old regime. Finally, they evidenced a hope, without stating it in so many words, that their responsibilities in other county engineering matters—drainage work, bridge building, repair and construction of county buildings—might become greater. In short, that their title of county engineer might assume a standing more in line with its possibilities.

Organization and Revenue—In Kansas, as elsewhere, county engineering work centers around highway activities, although other engineering work now and then falls to the lot of the county engineer. Each of the 105 counties in the state is governed by a board of commissioners that appoints the county engineer with the approval of the state highway engineer. The present law provides that 15 per cent of the highway mileage in a county shall be designated as the county system. As a result about 9 per cent of the total highway mileage in the state is in charge of county engineers. This is a small percentage, but the thousands of miles of township roads, should they be added to the county system, will increase it many times. There is a strong possibility that these township roads will come under the county engineers' jurisdiction soon, by the adoption of the so-called unit system of classification.

This unit system of highway classification—whereby all roads in a county are divided into three or more systems instead of being designated merely as county and township roads—is optional in the state, and had aroused only nominal interest and a few converts until the state took over the state highways. Now it is being

actively discussed, there are seventeen counties in which it is in force and its adoption is seriously forecast in numerous other counties. Such a system would probably contemplate the designation of the present main county system as class A, the mail route roads as class B, and most of the township roads as class C. Since all of these roads would be directly under the supervision of the county engineer, the adoption of the unit system would vastly increase his tasks and responsibilities. In most cases his mileage would be increased several hundred per cent. At present the county engineer enjoys some sort of supervisory control over township roads, but it seldom gives him opportunity for displaying any initiative. Usually the control method assumes the form of requiring his approval of all expenditures of the boards of township commissioners that exceed $200.

Money for county roads in Kansas comes from three principal sources—state gasoline taxes and motor vehicle licenses, general property taxes, and benefit district assessments. From the state gasoline tax and motor vehicle licenses the counties receive $900,000 every three months. This is prorated among the counties on a 40-60 basis—that is, 40 per cent divided equally and 60 per cent divided on the basis of assessed valuation. The amount received is divided equally between the county board and the township boards. At present the average amount received by both county and township boards is $19,000 annually. The general property tax is 1½ mills for county roads and 1½ mills for county bridges. Townships can levy 3 mills on all property outside of towns for a road and bridge fund. Where the unit system is in force, a general property tax of 3 mills for roads and 3¼ mills for bridges is permissible.

In some counties benefit districts are resorted to as a method of revenue raising. A benefit district is inaugurated by its members presenting a signed petition to the county commissioners. With the commissioners' approval a project automatically becomes a public utility, and bonds may be issued for financing it. By state law, when a benefit district is formed, the county can issue bonds for 60 per cent of the cost and the township for 25 per cent. The final 15 per cent is paid to the county by the property owners. Usually all bonds issued for benefit districts are county obligations, although the townships may if they desire issue their own securities.

FIG. 2—PONY-TRUSS BRIDGE, DESIGNED BY DOUGLAS COUNTY ENGINEER

Features of structure are elimination of all stringers by use of a continuous concrete floor slab, fixed ends of trusses on center pier and expansion on abutments, and cutwaters on both upstream and downstream faces of center pier. Advantages of pony truss are unrestricted overhead clearance, which benefits motor-truck haulage of live stock, and ease of painting and maintenance.

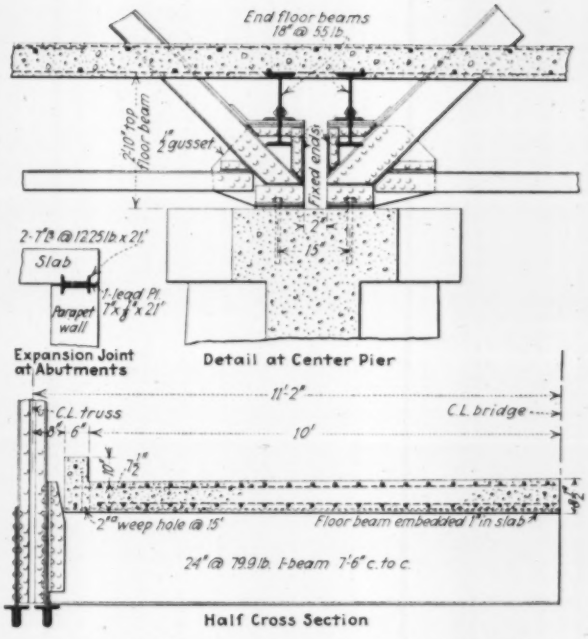


FIG. 3—DETAILS OF STRINGERLESS PONY-TRUSS BRIDGE, DOUGLAS COUNTY

The five Kansas counties considered in these two articles are Douglas, Franklin, Reno, Johnson and Lyon, as indicated in Fig. 1. Reno is the second largest county in the state, is directly in the center of the wheat belt and has a typical prairie topography. Johnson County adjoins Kansas City and presents an interesting problem of providing for suburban highways in a rural community. In Douglas County an unusual plan is followed of having the county engineer design and erect all bridges. Franklin County, immediately to the south of Douglas, is crossed by a network of small and fast-flowing rivers, and has an unusual bridge problem which is handled by a consulting engineer. In Lyon County the engineer has developed an interesting road surface, utilizing local pit gravel.

County Designs and Builds Its Bridges

County engineering in Douglas County is of general interest by virtue of the bridge-building procedure that is being followed. Probably in only a few counties of comparable population and wealth in the country is bridge work on county roads more completely in the hands of the county engineer. Lawrence, the county seat and largest city, has a population of about 15,000, while the next community is a third-class city of 4,000. Lawrence has some manufacturing plants—flour, paper, vegetable canning and pipe organs—but is primarily an educational center, containing the state university and Haskell Institute, the largest of the government Indian schools. Otherwise the county is strictly rural farming territory. The last assessed valuation was $47,000,000.

In the past eight years twelve steel bridges varying in length from 30 to 150 ft. have been erected, in addition to approximately 400 concrete structures of smaller size. This work has represented an average annual expenditure over the past eight years of $50,000. In 1929 the bridge levy of 1.16 mills raised about $54,500. There are approximately 100 steel bridges in the county, varying in span from 20 to 220 ft., and many of these have

FIG. 4—PORTABLE ROCK-CRUSHING PLANT ON BRIDGE WORK, DOUGLAS COUNTY
Limestone is usually available for abutment concrete at all bridge sites. This 9x16-in. jawcrusher, belt-operated from a tractor, is part of the bridge crew's standard equipment.

outlived their usefulness and must be replaced. Activity in bridge building, therefore, will probably increase rather than diminish. All of the bridges constructed on county and township highways within the past eight years have been designed in the county engineer's office and erected by force-account crews under his direction.

being built. Camps maintained for these bridge gangs utilize knockdown structures which can be transported easily on trucks. Each gang has its own tools and is supplied with a 3-ton truck. The concrete gangs have available two 8x12-in. jawcrushers and one 9x16-in. jawcrusher, all tractor operated. A good limestone rock suitable for concrete aggregate is usually within easy reach of any bridge job. Also the removal of this rock from the hills often assists in reducing steep gradients.

In carrying out the bridge program, several practices and structural details have been adopted which are of general interest. No state standards are used on either concrete or steel structures unless these appear to be the most economical for the location. In general, reinforced concrete is used for all stream crossings with spans of less than 20 ft. For spans from 20 to 35 ft., structures with concrete abutments, I-beam stringers and a concrete deck are used. Above 35-ft. span and up to 100 ft., steel pony trusses are standard.

A Stringerless Bridge—An interesting design of a pony truss has been adopted by the county and is being utilized wherever possible. Trusses up to 75-ft. span have been erected and designs are made for other structures up to 100-ft. span. Floorbeams are used at the

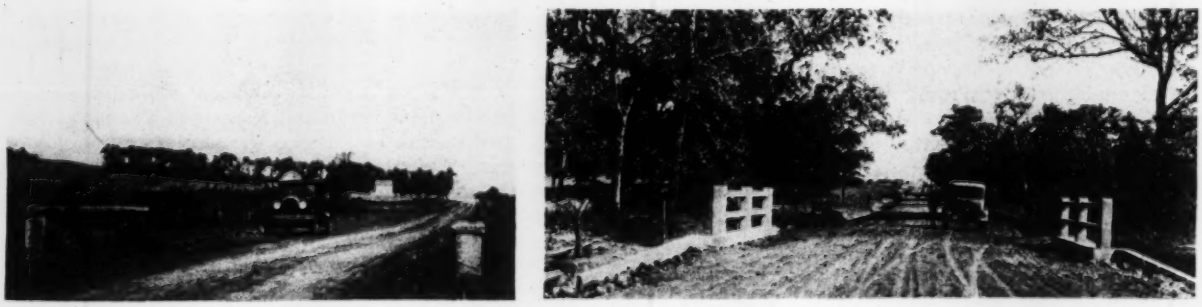


FIG. 5—OLD AND NEW CONCRETE CULVERTS, DOUGLAS COUNTY
The old headwalls were eliminated in favor of railings, which can be seen more easily and at the same time have a more pleasing appearance.

What is the organization of a county engineering force that handles such work? In Douglas County it is headed by a county engineer, E. E. Trueblood, who has a background of sixteen years of experience in responsible positions in both the design and construction departments of one of the leading bridge companies of the country. His qualifications thus are unusual and largely explain the responsibility in bridge matters which is his. The county engineer is assisted by a graduate civil engineer who divides his time between the drawing-board and the field. A clerk handles all of the non-technical records. A surveying party is utilized to give lines and grades on highway work. This is headed by the county surveyor, a part-time official, who works for the county engineer's office on a fee basis. This man also handles all legal and private survey work in the county.

In the field, two to four bridge crews are at work the year around. While township roads are handled by township boards and not by the county engineer, the latter is required to build all bridges over 20 ft. in span and to supervise work on the smaller structures. As a matter of fact, a county bridge crew does practically all of the township bridge work that is done.

Each bridge crew is made up of a foreman, a form builder, a truck driver and a tractor driver, and three to six laborers who are enlisted largely from among the farmers in the neighborhood in which the bridges are

sub-panel points as well as at the main panel points, and a concrete slab 7½ in. thick at the edges and 8½ in. thick at the center is placed as a continuous floor. Being supported at the panel and sub-panel points by the floorbeams, no stringers are required. The pony truss has a considerable advantage over the through truss on county roads, because the large amount of stock haulage in motor trucks makes overhead clearance an important factor. The pony truss also is easily painted.

FIG. 6—SINGLE POSTS MARK SHORT BOX CULVERTS, DOUGLAS COUNTY

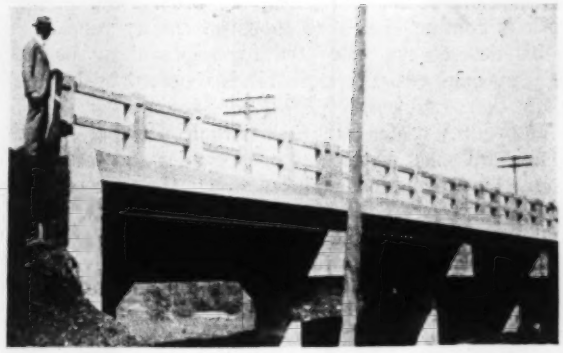


FIG. 7—TRESTLE WITH REINFORCED-CONCRETE BENTS, I-BEAM STRINGERS, CONCRETE FLOOR AND RAILING, DESIGNED BY DOUGLAS COUNTY ENGINEER

Economy, in addition, is a factor in the use of these pony trusses, even when two of them are necessary to effect a crossing. In one particular instance a stream was bridged by means of one 60-ft. and one 75-ft. pony truss. Estimates showed that the comparable costs were $13,000 for the bridge as built, as against $18,000 for a 110-ft. through span. This saving was effected by the use of very small abutments, the extra pier not offsetting the additional cost that the heavy abutments for the 110-ft. through-truss span would have required. A view of this pony-truss bridge is shown in Fig. 2. Because of much floating debris during high water, a pier design involving cutwaters both upstream and downstream has been developed. The upstream cutwater is armored with a steel angle. On these bridges, the trusses are fixed on the center pier, with rocker bearings on the abutments. Such an arrangement has simplified the pier design and does not materially affect the cost of the abutments. In most of these structures it is impossible economically to excavate the abutments to rock, but they are always placed below the sliding strata and if necessary on piling. The practice is to paint the steel bridges every six years.

Concrete Structures—One of the interesting practices adopted on concrete culverts involves the use of curbs 15 in. high in order that there may be some 9 to 12 in. of dirt on top of the concrete slab. In times past, in order to get sufficient capacity for the culvert, the top slab had been raised so high that the dirt was soon worn off; thus, the concrete was not only exposed to traffic but became an obstruction for the maintenance graders. Deep approach channel grading is now resorted to in providing sufficient waterway capacity.

The concrete culverts are in reality rigid frames, in contrast to the state standards, which assume self-supporting abutments and provide expansion for the slab at each end. Douglas County designs require abutments about 12 in. thick placed on a base 3 ft. wide for all spans up to 18 ft. Expansion is taken by slight bending in the abutments, and the necessity for cleaning expansion openings at the ends of the culverts is eliminated.

Recently a change has been made from low-head walls on the concrete culverts to high handrails. The latter are more easily visible and also much more sightly. Another structure of special design that has recently been completed is a concrete trestle viaduct 107 ft. long, shown in Fig. 7. The trestle was adopted instead of the steel truss because of the former's lower cost and because foundation problems were not vital factors at this particular location. Another county innovation adopted, following the washing out of several bridge abutments, is the use of wing walls placed at 45 deg. with the direction of the current to deflect it and the debris toward the center of the stream.

The county engineer, as previously stated, has supervisory powers over township bridges. It is only a matter of time, in the opinion of the county engineer, when the unit system will be adopted in which all township roads are made a part of the county system. In view of this possibility, he is doing everything possible to keep the township roads in good condition and to improve them where possible. Many of the old bridges which are being removed from county roads as inadequate are being re-erected on township roads where single-lane bridges, capable of carrying only light loads, are suitable.

There are approximately 900 miles of roads in the county, 75 miles being in the state and federal system, about 150 miles in the county road system and the remainder in the township system.

Consultant Aids County Engineer

Engineering in Franklin County is unique in that the county engineer is assisted by a consulting engineer retained to handle all bridge matters as well as to prepare all plans and specifications for major new construction of highways. The county engineer, on the other hand, is administrative officer and handles all routine construction and maintenance.

Topographically, Franklin County is quite hilly. Especially in the north and west the county is rolling and is crossed by many streams, most of them flashy, rising out of their banks almost overnight and making the provision of adequate and economical bridge openings a difficult task. The principal stream, the Marais de Cygnes River, is one of the most treacherous in the state. Ottawa, the principal town and county seat, in the approximate center of the county, has a population of about 11,000. The next town in size has a population of less than 1,000. Ottawa, therefore, is the focal point of the county, and all highway construction is planned with the idea of giving residents easy access to it.

History and Development—Seven years ago, when E. W. Loveless came to Franklin County as county engineer, there was a well-defined antipathy toward any road expenditures. The residents had always done their traveling on unimproved highways in buckboards and lumber wagons and could continue to do so on the existing roads. Furthermore, a benefit district had been formed in 1920 to build about 23 miles of brick pavement, and because of the high cost of materials the first few miles had cost

FIG. 8—TRIMMING HEDGE TREES THAT SHADE EARTH ROAD, FRANKLIN COUNTY

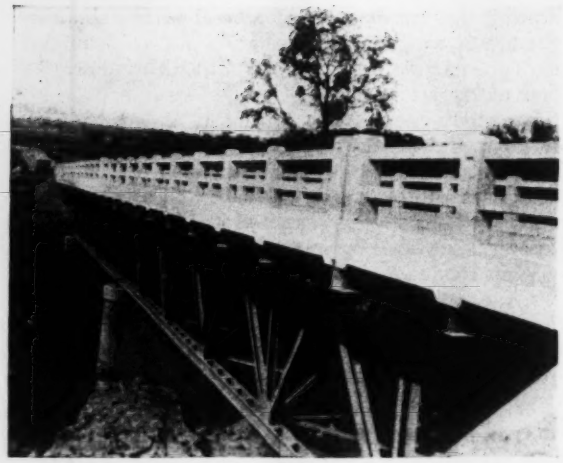


FIG. 9—DECK TRUSS 220 FT. LONG ON A 5 PER CENT GRADE
Designed by Franklin County's consulting engineer.

about $55,000 per mile. This naturally had made good roads a sore subject.

The county engineer's first job, therefore, was to create new interest in highways. In this he was aided by the increasing use of automobiles, but in addition Mr. Loveless believes that his own efforts were not without beneficial results. His tactics were first to win the friendship of influential business men in the county; this opened the way for him to impress them with the necessity of better roads. After that it was a case of letting the people decide for themselves, and of building "show roads" whenever funds permitted.

These experimental "show roads" are still being constructed by the county engineer and they still produce results in that benefit districts are constantly being formed to copy them. Only recently he has completed a 1,200-ft. section of brick pavement on which the side slopes in cuts are terraced. There are no ditches, the water running down the pavement to the bottom of the slope, where angular spillways lead it to the cross-ditches. The next step is to provide catchbasin spillways at intervals along the road so that the water does not have to flow so far on the pavement. There are numerous places in the county where such a road would prove economical and the county engineer hopes that this "show road" will assist him in selling a similar pavement for these locations.

Bridge Practice—Previously, when the state roads were under county control, the consulting engineer designed most of the bridges in the county, but now his work is confined solely to those on county roads. All of his designs are submitted for approval to the state highway engineer, although this is required by law only where the cost exceeds $2,000 per structure.

The county engineer furnishes the consulting engineer all field information such as lines, grades and foundation data. The consulting engineer selects the type of structure and prepares all plans and specifications. He is paid a percentage of the contract price as a fee. He also prepares plans for highways, but is paid for this work on a mileage basis. His highway plans include earthwork quantities and culverts under 20-ft. span.

The longest bridge so far built has a span of 272 ft. Another major structure, a deck truss, is shown in Fig. 9. Designs have also been prepared for a long viaduct over the Santa Fe railway tracks, and this structure has recently been placed under construction.

Although all types of bridges are used, steel trusses predominate. Parallel chord trusses are used up to 90-ft. span; over 90 ft. a truss of camelback outline is generally considered best. Because of the driftwood during floods, stream piers are eliminated wherever possible.

FIG. 10—HEDGES ARE CUT TO 3-FT. HEIGHTS FOR 200 FT. BACK FROM INTERSECTIONS
Note top of car around the corner, visible over hedge.

FIG. 11—FRANKLIN COUNTY EARTH ROAD, FRESHLY MAINTAINED AND RECENTLY GRADED

State standards are used on all culverts. They are of the single- or multiple-box types with openings up to 10x10 ft. Special designs involving stepped flumes have often been necessary to eliminate erosion by reducing discharge velocities.

All bridges are financed out of a bridge fund resulting from a general tax levy, the amount of which is estimated each year and included in the engineer's budget. The budget for 1929 for bridges was $90,000. Within the past seven years the county has spent approximately $500,000 on its bridges. All bridges are painted every three years.

Highway Plans—The ultimate highway plan is to surface every mile of county road. This surface will be sand, gravel or chat, although a hard surface may be placed on short lengths. All of this work will follow state standards except as to width. State roads are 30 ft. wide; the county roads will vary between 26 and 30 ft. Ditches are standard except that bottoms are made somewhat wider to cut down erosion and to eliminate the possibility of a car upsetting too easily. A 3:1 slope is used with a 1½:1 back slope. The ditches are 18 in. deep.

Grading is accomplished as rapidly as possible, followed, when sufficient settlement has taken place, by

surfacing. The sand or chat is windrowed along one side of the road and graded into the center as it is needed.

Every market center in the county is connected with Ottawa by a surfaced road which indicates that progress is being made. Next the market centers will be connected with market centers in adjoining counties, and this work will be followed by improvement of the mail routes.

The only way major projects can be carried out is by means of benefit districts, and 70 miles of high-type construction is now being financed by this means.

Maintenance—Maintenance is carried on by the patrol system, both power and horse outfits being used, although the latter are being eliminated as rapidly as possible. Power-patroled sections are 20 miles long and graders with 14- or 16-ft. blades pulled by 5-ton tractors are used. The average length of horse-maintained sections is 8 miles, and a 10-ft. blade grader is used. The county also has three outfits of 10-ton tractors and 12-ft. graders

FIG. 12—STATE STANDARD BOX CULVERT ON FRANKLIN COUNTY ROAD

for ditch maintenance and construction grading. Records show that the maintenance cost is approximately $25 per mile less for power-maintained than for horse-maintained sections. The average annual maintenance cost for all sections is $170 per mile on the dirt roads. On the sections of brick road, the annual maintenance has been approximately $40 per mile.

Weeds on the side slopes are cut by machine. County prisoner labor is used to pull hedges, as well as to cut weeds with scythes and corn knives. A concerted attack is being made on all hedges because they shield the road from the sun and catch snow in winter. Also they are dangerous at intersections, where they are being removed for 200 ft. back from the corner.

Other Work—At the present time there are two drainage districts under the county engineer's supervision. His principal task is to build and maintain the ditches. The existing districts are small, but numeorus others are being planned.

Accident prevention is one of the county engineer's self-appointed tasks, largely because the public blames most highway accidents on road conditions. Pictures are taken of all accident locations for study and reference after the alleged bad condition has been remedied. All wood guard rails are being eliminated as unsafe. Cables and mesh with concrete posts are being substituted.

Next Article—The second and concluding article, to be published soon, will deal with job practices in the three remaining counties, Reno, Johnson and Lyon.—EDITOR.

Progress in Preventing Pollution From Industrial Wastes in Wisconsin

ENCOURAGING results from studies in the prevention of water pollution by various kinds of trade wastes are reported by the bureau of sanitary engineering of the Wisconsin state board of health.

Milk wastes can be rendered unobjectionable from the stream pollution viewpoint by treatment on broken stone trickling filters at reasonable cost, experiments at De Forest, Wis., show. The stone should be ½ to 1 in. in size, have an effective depth of about 8 ft. and a surface sufficient to keep the dosage rate down to 2,000,000 gal. daily per acre of filter area. Periodic dosage can be accomplished satisfactorily by tip-troughs or siphons and uniform distribution of the waste over the filter by V-shaped boards or perforated plates. Housing of the filter is considered necessary in locations where severe winter conditions are encountered. Good purification results can be obtained with lath filters. Results obtained with the activated-sludge process on a practical scale of operation were not satisfactory.

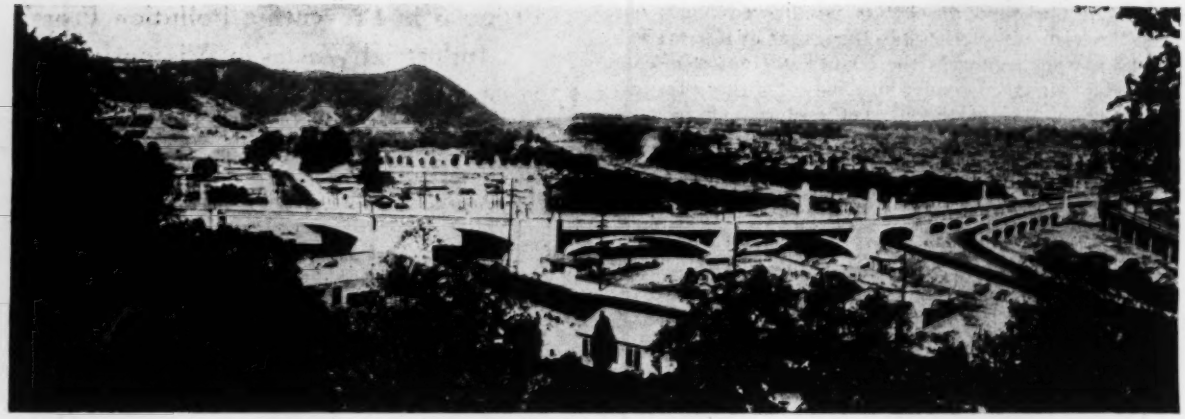
At fifteen pea canneries waste-treatment plants of the chemical precipitation type have been installed. These have been operated under the supervision of a chemist employed by the Wisconsin Canners Association working in co-operation with the state board of health. Satisfactory and economical treatment methods for removing polluting substances from corn, beet, bean and kraut wastes are being sought. Studies have been made of the screening-soil absorption method of cannery waste disposal, with chlorination for odor control. Results indicate limited application for this disposal method.

A survey of pulp and paper mills in Wisconsin has been completed in connection with the co-operative waste utilization and stream improvement program.

Special sewage-treatment studies at Fond du Lac indicate that effective results can be secured with sewage mixed with equal volumes of tannery wastes which have received preliminary sedimentation. The digestibility and drying characteristics of the sludge removed from the combined sewage and tannery wastes do not seem to be impaired. Sludge-digestion rates were retarded with increasing concentrations of tannery sludge.

Photo-Electric Apparatus Indicates Air Conditions in Holland Tunnel

Experiments are being performed in the Holland tunnel on the use of a photo-electric cell to indicate the concentration of exhaust gases in the atmosphere. As used at present, the light sensitive device is located in an exhaust duct over the traffic lane at a point near the New York exit where the roadway grade is at its maximum and where the amount of exhaust from the heavy truck traffic is greatest. By means of mirrors, a beam of light is caused to travel 300 ft. from an electric lamp to the photo-electric cell through the air being exhausted from the tunnel. The photo-electric current, after being amplified, operates an indicating and recording device located a quarter of a mile from the tunnel's portal. An indication of increasing haziness is a signal to the supervisor to increase the amount of ventilation. The equipment is being developed by the General Electric Co. along lines suggested by the engineers in charge of the tunnel.



VIEW OF COMPLETED GLENDALE-HYPERION VIADUCT

At the left (south) end appear the two 118-ft. barrel arches, Riverside Drive passing under the second. To the north are the two 135-ft. spandrel arches, with the 68-ft. barrel arch next, crossing one-half of Glendale Boulevard. The remainder of the main viaduct consists of eight 48-ft. barrel arches and is flanked by a series of six 48-ft. arches on either side.

Designing the Hyperion Viaduct at Los Angeles

Continuous Concrete Arch Structure Solves Difficult Traffic Problem—Stress Calculations Checked by Beggs Machine—Two Design Methods Compared

By Merrill Butler and A. L. Enger

Engineer of Bridges and Structures and Project Engineer, Bureau of Engineering, Los Angeles

THE Glendale-Hyperion viaduct was recently built by the city and county of Los Angeles at a cost of about $1,600,000 to improve the main traffic artery between the city and Glendale, a residential suburb. It is located at a point where the boulevard crosses the Los Angeles River and forms a junction with Hyperion Ave. A complicated structure was required to permit an uninterrupted flow of traffic at a three-way intersection. Features of the project are a 1,300-ft. viaduct of concrete arches supplemented by two smaller concrete viaducts, an electric railway underpass and one street grade separation. The solution worked out for the traffic problem and the methods used in the design of the concrete arches are described in this article.

A serious obstacle to the development of the Los Angeles major traffic plan existed in the vicinity of the Los Angeles River crossing of the Glendale Boulevard. A traffic bottleneck, an electric-railway grade crossing and a proposed junction with a new crosstown thoroughfare were features of the problem to be solved.

Glendale Boulevard is the main traffic artery from Glendale and the neighboring communities to the heart of Los Angeles. Prior to the present improvement the electric-railway tracks which split the boulevard on the Glendale side of the Los Angeles River crossing into two 39.5-ft. roadways left the boulevard at grade to cross the river on a separate bridge, making a grade crossing for half the traffic. In addition, the boulevard crossed the river on an old timber trestle only 24 ft. wide which had been inadequate for several years, producing traffic jams regularly during the morning and evening rush hours.

A second major problem was introduced by the requirement of the traffic plan to split the boulevard at this point to provide a connection with the new Hyperion Ave. This street was being opened to give a direct outlet west to Hollywood, Beverly Hills and the Santa Monica Bay district without entering the heavy-traffic section of Los Angeles. The new connection, in addition to a crossing over the river channel, required a long ascending grade to gain the high ridge running parallel to the river on its western side. Between the river and the ridge the new connection crosses an important cross-traffic street and on top of the ridge it intersects a residential street.

In brief, the problem consisted of the following features: (1) to carry traffic of both Glendale Boulevard and Hyperion Ave. across the Los Angeles River; (2) to provide a junction between these two main traffic arteries in such a way as to minimize cross-traffic interference; (3) to eliminate the electric-railway grade crossing; (4) to cause minimum injury and damage to adjoining property, and (5) to provide the solution within a reasonable cost.

Solution of Traffic Problem—The accompanying diagram (p. 479) shows the method of solving the problem. The solution is the result of several compromises to meet the various problems. Viewed from the Glendale side of the river, the major part of the improvement consists of a viaduct 1,300 ft. long with a 56-ft. roadway and two 5-ft. sidewalks forming a continuation of the center section of the main boulevard. This viaduct, forming the beginning of Hyperion Ave., crosses the river on a 4 per cent ascending grade to an underpass at the crest of the ridge. The Los Angeles-bound traffic on the boulevard occupies the

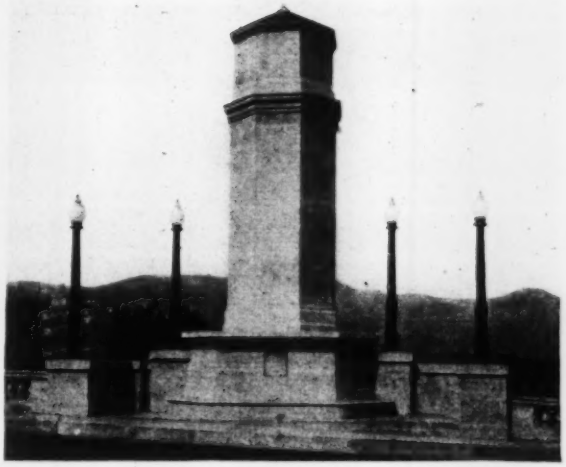
extreme right-hand side of the highway and is carried across the river on a series of small arches providing a 28-ft. roadway with one 5-ft. sidewalk adjacent to the main viaduct and then turned to pass beneath it to form half of the continuation of Glendale Boulevard. The Glendale-bound traffic from this latter junction point crosses the river on a similar roadway adjacent to the other side of the viaduct and, joining the Glendale-bound traffic of Hyperion Ave., passes under the electric-railway tracks and then rises to form half the combined boulevard.

This general solution involved several minor problems. Hyperion Ave. was depressed 20 ft. below the ridge crest to reduce the grade on the viaduct and at the same time to provide a grade separation at Waverly St. Grade separation of Hyperion Ave. and Riverside Drive was automatically effected by the construction of the viaduct, whereas Glendale Boulevard and Riverside Drive continue to cross at grade. Lack of funds do not permit a separation for this intersection at present, although the new construction was designed to permit a separation at this point in the future.

The additional land required for the viaduct was obtained by eminent domain proceedings. Upon completion of the project, traffic increased to the full capacity of the streets, although there was no apparent diminishing of traffic on parallel streets. Some additional work remains to be done in removing obstructions on approach streets to increase the capacity of the viaduct.

Selection of Spans—After the general requirements of grade and alignment had been determined, the next phase of the problem was to select the type of structure and the span lengths at various predetermined openings. It was particularly desirable to have a single clear span where the viaduct crosses Riverside Drive near the south end of the viaduct. The length and skew of this span were fixed by the direction and width of that street; a 118-ft. arch was required. The configuration of the ground at this point made it advisable to continue an arched structure in each direction. To the south this was desirable because of the possibility of a future rapid-transit line which would require an opening equal to the one provided for Riverside Drive. Thus another 118-ft. arch was selected for the viaduct immediately south of Riverside Drive. This span carried the structure to a location where suitable material was found for an abutment marking the southern end of the main viaduct.

North of Riverside Drive long spans were necessary to counterbalance the thrust from the two very flat 118-ft. spans and also to provide adequate openings

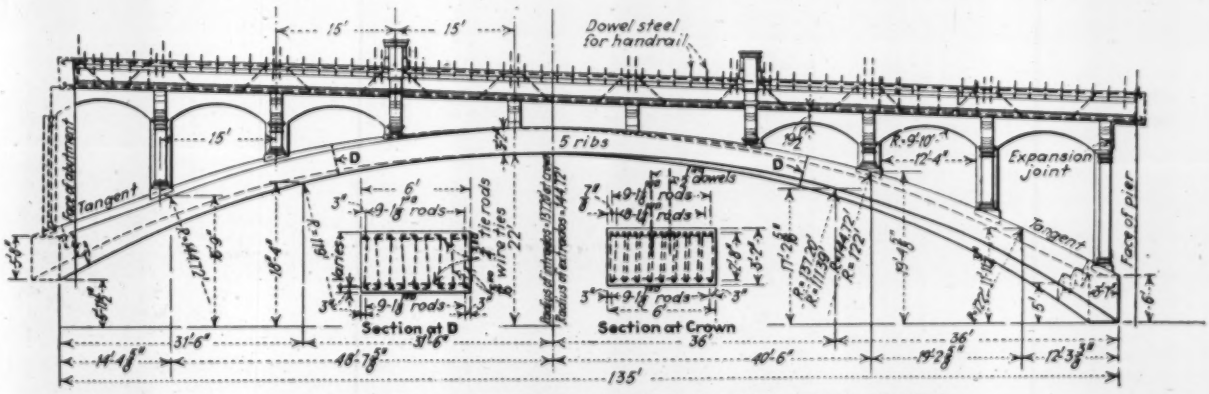


ORNAMENTAL PYLON AT ARCH ABUTMENT
These groups mark the ends of the 135-ft. arches.

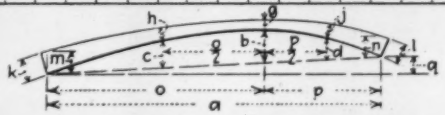
over certain city-owned lands which the city plans to develop for park purposes. Two open spandrel arches were selected for this part of the viaduct because of the curvature of the deck on one span and because the 135-ft. span exceeded the economical limit for a solid spandrel filled arch. The direction of piers for these two arches was kept parallel to Riverside Drive. The southerly face of the abutment at the end of the two 135-ft. spans was parallel to Riverside Drive, while the northerly face was made parallel to the center line of the roadway carrying the Los Angeles-bound traffic from Glendale Boulevard under the main structure. A 68-ft. arch provides the next unit, selected to give the proper clearance for this roadway. The abutment at the north end of this span provides the necessary change in direction to bring the skew of the piers to the north parallel to the bed of the Los Angeles River.

The 48-ft. span lengths across the river were selected because they appeared to provide a maximum of clearance at the most economical cost. Filled spandrel arches were used largely because of the economics of the problem, although it was felt that the additional weight might be very desirable for the spans over the river as an added factor of safety against floods.

Test holes to determine foundation conditions showed that the river apparently had cut a valley out of the original hard clay stratum and subsequently filled it with sand and gravel. Churn drill test holes were sunk first, followed by test pits to inspect the stratum in its



ELEVATION OF 135-FT. SPANDREL ARCH SHOWING STEEL IN RIBS

Type	a Clear Span	b Rise	c Rise at ¼ Pt. (L)	d Rise at ¼ Pt. (R)	e 100c/a	f 100d/b	g Crown Thick.	h Thick at ¼ Pt. (L)	i Thick at ¼ Pt. (R)	k Thick at Springing	l Thick at Springing	m Thick at Sp. (L)	n Thick at Sp. (R)	o	p	q
Barrel	48'	4.83'	4.00'	4.00'	8.27'	8.27'	1.25'	1.3'	1.3'	2.5'	2.5'	2.7'	2.7'	24'	24'	0.92' 2.14'
"	68'	6.98'	6.72'	5.59'	8.90'	8.00'	1.33'	1.5'	1.5'	3.3'	3.2'	3.50'	3.25'	39'	29'	2.54'
"	118'	11.50'	10.61'	8.42'	9.27'	7.32	2.17'	2.3'	2.3'	4.0'	4.0'	4.2'	4.2'	72'	46'	5.28'
Spandrel	135'	18.82'	13.76'	15.60'	7.30'	8.28	3.17'	3.3'	3.3'	5.1'	5.4'	5.67'	6.00'	63'	72'	5.96'

PRINCIPAL DIMENSIONS OF VARIOUS ARCH SPANS

natural condition. Later foundation excavations checked the results obtained by the test holes and pits.

Foundation conditions required the use of two types of footings—namely, spread footings with piling and spread footings without piling. Hard shale at some of the foundation locations made the use of piling unnecessary if not impossible. Where the foundation material consisted of sand or gravel, piles were driven. Concrete piles were selected because heavy pumping draft in the vicinity indicated that the groundwater level might fall below the top of the piling.

In view of the actual results of the piledriving work, it appears that the selection of concrete piles was fortunate because the difficulty in driving resulted in increased carrying capacity that made them as economical as wooden piles.

The continuous type of arch span with elastic piers was the type of structure decided on at the beginning of preliminary studies. The reason for the selection was that considerable saving could be effected in the piers by designing them as elastic structures and in addition the general layout of the viaduct facilitated the construction of four main abutments which were well located to take the main thrusts.

Arch Analysis—Unsymmetrical arches were required because of the 4 per cent grade of Hyperion Ave., although the amount of design work was increased to a considerable extent for this reason. The 48-ft. arches are three-centered and are tilted to fit the grade. All other arches are four-centered, being compounded at the crown and at points approximately half way between crown and springing lines.

Each group of arches was considered fixed at the abutment and at the top of the pier footing. Piers were considered as elastic and in the continuous arch spans of each system the arches are similar in shape, span and loading. It is evident that if the pier tops of a continuous system are subjected to equal and opposite horizontal loads from the arches resting upon them, each pier top will be in equilibrium and the arches may be considered as fixed at the springing line. In such case the elasticity of the pier would have no effect on the stresses in the arches. For dead load, temperature and rib-shortening the foregoing condition is approached very closely, and the single-span analysis gives satisfactory results.

The mathematical method of analysis followed as far as possible was the elastic method of arch analysis given in Vol. III of Hool's "Reinforced-Concrete Construction." Dead-load stresses, rib-shortening and temperature stresses were obtained with this method by analyzing a single span. This solution was found quite satisfactory for single spans with the exception of the method of correcting for rib-shortening. The method computes the rib-shortening on the basis of an average compression, due to uncorrected thrust. In arches having a fairly high rise and shallow section there is a small amount of rib-shortening and the error is negligible. However, for flat arches of fairly great depth of section the error is large and it was found that if the rib-shortening were computed according to the text and divided by the horizontal thrust a factor was obtained which closely represented the ratio of rib-shortening to horizontal thrust for any loading. The corrected horizontal thrust would be the calculated horizontal thrust divided by 1 plus the rib-shortening factor.

The results of this simple method of correction agree with results obtained from more exact and complicated formulas such as presented by Howe and others. Rib-shortening corrections for temperature effects were made in a similar manner. The difference between the uncorrected and corrected horizontal thrust is the rib-shortening thrust to be used for calculating the rib-shortening moment.

Analysis by Models

Use of Models—Because of the formidable character of the mathematical method of analysis and to give an independent check upon the usual methods, the Beggs method of analysis by means of models and deformeter gages was used to supplement the design studies. This

TEMPORARY TRAFFIC ROUTE DURING CONSTRUCTION
Arches for Glendale Boulevard appear at either side of main viaduct. The railway underpass is shown already completed.

method was used primarily to obtain the effect of live loads but also was used as a check on the dead-load reactions as compared with the elastic method of analysis. As an example of the comparison between the two methods there is shown in the accompanying table the dead-load reactions for the abutments of the six 48-ft. barrel arches; all calculations are based on a 1-ft. strip.

From the table it is observed that the results for horizontal and vertical thrusts obtained by the two methods agree closely but that the moments are more erratic. This is the usual experience with mechanical methods of arch analysis, and tests with the same model or with two models for the same arch will show greater variation in the results for moment than for the horizontal or vertical thrust.

It probably is true also that in the structure itself variations from design assumptions have more effect on the moment than on the two components of the reaction. For example, in a single-span beam, partly fixed at one end, different conditions of fixity vary the moment at the support through a very wide range, while the vertical reaction remains comparatively constant.

ELASTIC METHOD FOR A SINGLE-ARCH SPAN

Horizontal thrust, lb.	31,260
Corrected horizontal thrust (rib-shortening calculated on the average compression due to above thrust = 10,720 lb., or 0.343 times the horizontal dead-load thrust. The corrected horizontal thrust is therefore 31,260 divided by 1.343), lb.	23,300
Vertical thrust (corrected for rib-shortening), lb.	12,600
Moment (corrected for rib-shortening), ft.-lb.	—21,360

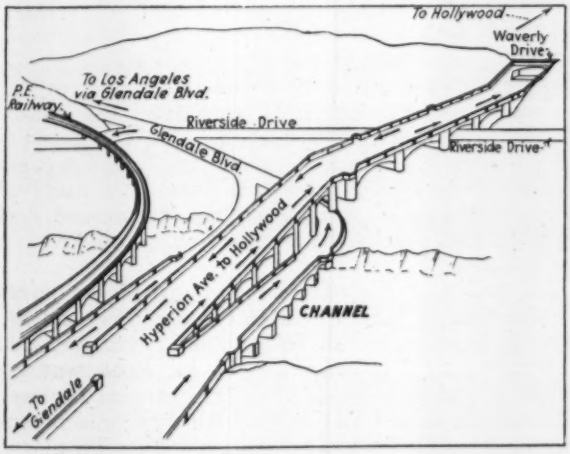
Beggs Method for a Single-Span Model

Horizontal thrust, lb.	23,330
Vertical thrust, lb.	12,740
Moment, ft.-lb.	—6,840

Beggs Method With a Six-Span Model

Horizontal thrust, lb.	24,300
Vertical thrust, lb.	12,300
Moment, ft.-lb.	—22,560

The general results obtained by the Beggs method were considered quite accurate for the model tested, but certain limitations and difficulties were encountered. Trouble was experienced in making the model accurately represent the structure to be analyzed. Cardboard was used for the first models but did not prove entirely satisfactory because of its lack of complete homogeneity, resulting in different characteristics in different directions. In addition, cardboard proved very sensitive to changes in humidity, and as a result the bridge division now uses celluloid exclusively for the construction of models. To represent a continuous arch system the size of sheets from which the models could be cut often required the use of a small scale, resulting in the models being delicate and fragile. Such a model was difficult to set in the gages without stressing the material beyond its elastic limit and in the small-scale model the errors introduced in laying out and cutting are proportionately large.



SKETCH OF STREET ARRANGEMENT TO SOLVE TRAFFIC PROBLEM

LOOKING ALONG VIADUCT FROM GLENDALE END
Approaching traffic uses railway underpass in left foreground.

Accuracy in the dimensions of the models is essential, not only along the axis but also in regard to the depth of the section, for the secondary stresses are a function of the depth. This point is of great importance, since temperature stresses vary as the cube of the depth of the arch, and rib-shortening stresses (for a given load, given arch axis and a given variation of moment of inertia along the axis) vary as the square of the depth. In general, the models were cut to agree with the usual design assumptions and the errors of such assumptions appear in the Beggs results, just as in the mathematical analysis. However, in some cases the assumptions for the Beggs method may be made to follow the actual conditions in the structure more closely than the usual design assumptions.

It is not satisfactory to use reactions determined by the Beggs method at one point for calculating the reaction at another point. For instance, if the reactions at the springing line of an arch of a 100-ft. span and a 10-ft. rise were obtained by the Beggs method for a single load at the crown, the reactions (H_s, D_s, M_s) will have a probable error of at least 1 per cent. The crown reaction then would be:

$$H_c = H_s \pm 0.01,\ V_c = V_s \pm 0.01$$

$$M_c = 50\ (V_s \pm 0.01\ V_s) - 10\ (H_s \pm 0.01\ H_s) + (M_s \pm 0.01\ M_s)$$

$$M_c = (50\ V_s - 10\ H_s + M_s) \pm (+\ 0.5\ V_s + 0.1\ H_s + 0.01\ M_s)$$

The possible error in this case likely would be many times the true value of M_c.

Reactions for points on the interior of the model may be obtained by fastening deformeter gages to the model at the desired point and cutting the model. Both halves of the gage must be fastened to the model before cutting and all gages except those at supports must be arranged so that they will be free to move

with the model, by supporting them on ball bearings. Because of the complexity of the various arch systems in this viaduct the Beggs method was depended upon entirely for live-load studies. The results of this method were checked by mathematical methods whenever possible and the agreement between the mechanical and mathematical method, where such checks were made, was very satisfactory. This fact resulted in a feeling of confidence in the use of the mechanical method. One of the great advantages of the Beggs method is that it opens up a new line of attack for the analysis of structures and, besides giving accurate results for structures too complicated for satisfactory mathematical analysis, also provides the designer with a clearer understanding of mathematical methods. This in turn indicates the possibility and desirability of further mathematical work.

Loads and Stresses—The live-load calculations were based on the weight of a 21-ton steam roller (plus 10 per cent impact) followed and preceded by a uniform load of 200 lb. per square foot. It was assumed that there might be six rollers across the width of the viaduct but only one roller per longitudinal strip in each span. For continuous spans a second roller was assumed in the adjoining spans. This loading is equivalent to a mass of heavily loaded trucks jammed together as closely as possible from curb to curb. Influence lines plotted from the Beggs readings were used to determine the live-load reactions. The following maximum stresses were used in design:

Concrete	Lb. Per Sq.In.
Compression in extreme fiber	750
Compression in extreme fiber adjacent to supports of continuous beams	850
Shearing stresses in beams without web reinforcement	50
Shearing stresses in beams with steel web reinforcement	150
Punching shear in footings	150
Bond (deformed bars)	120
Reinforcing steel, tensile strength	16,000

In some instances the stresses in the arches, computed for full live and dead load, including the effect of a temperature drop of 35 deg., were permitted to exceed these listed stresses, but in no case was a stress of 1,050 lb. per sq.in. exceeded.

All of the arches are built on a skew, but the skew effect was negligible for the Waverly St. arch and in the 48-ft. arches, which have angles between face of abutment and center line of the roadway of about 83 deg. and 71 deg. respectively. The 135-ft. spans, because of open spandrel construction with five separate ribs, required no particular provisions because of the skew. The 118-ft. arches of barrel type have an angle of about 59 deg. between center line of roadway and face of abutments. To avoid stresses due to this large angle of skew in the solid arch ring they were poured in ribs, with construction joints between them. It was found that all of the construction joints opened up, showing that the ribs acted independently as planned. The 68-ft. arch with an angle of approximately 60 deg. was treated in a similar manner. There is no evidence whatever of any distress in any of the arches, piers or abutments on account of the skew.

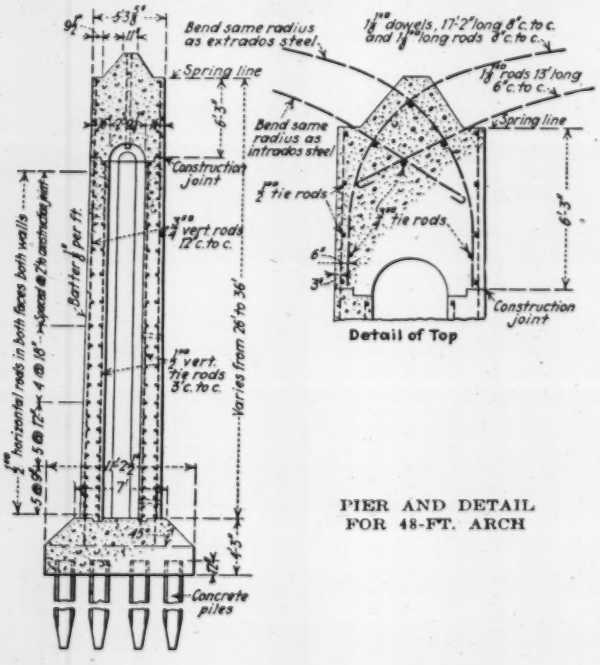
The abutments are the cellular or buttressed type. The barrel arches bear against thrust beams, the reaction of the beam being transmitted to the footing slab by buttresses, while the ribs of the open spandrel arches abut directly against the buttresses. The thrust beams were designed to be safe against shearing stresses, the bending moment being relatively unimportant. The exact analysis of the buttresses is impossible, being similar to analysis of buttresses in dams. The principal stresses are readily obtainable at a few points, but approximations must be made as to the stresses in other places. Designs of the buttresses are on the side of safety, it being more satisfactory to use extra reinforcing steel than to rely on elaborate analyses based on doubtful assumptions.

For architectural reasons the pier shafts are thicker than is required to carry the vertical reactions of the arch; therefore it was decided to make them hollow. Shafts were designed for bending and direct stress and were found to require but little reinforcement. The vertical components on the piers supporting unloaded spans were not sufficiently large to be measured by the Beggs apparatus, but as the direction of the reactions was known, the vertical components were calculated from the horizontal components.

The architectural treatment is very simple, more reliance being placed on the harmonious proportioning of the viaduct than upon the use of applied ornament. Pylons are used to set off the design units of the main structure, as shown in the illustration on page 477. Large pylons are placed on abutments at each end of the open spandrel arches to emphasize the 135-ft. arches. The lighting standards are cast bronze especially designed by the architects of the bridge division for this structure. Experiments have been made as to the possibility of floodlighting the viaduct and it is expected that a satisfactory plan will be worked out and installed.

The design of the structure was carried out under the direction of John C. Shaw, city engineer, and the writers as engineer of bridges and structures and project engineer, respectively. R. H. Rook was inspector of public work, H. P. Cortelyou was engineer of construction and L. E. Meidroth was resident engineer.

An article on construction of this viaduct will be published in an early issue.—EDITOR.



PIER AND DETAIL FOR 48-FT. ARCH

Wind on Tall Buildings

A Workable Method of Computing Lateral Stresses Involving Shear Distribution on Basis of Relative Stiffness of Wind Bents and of Column-to-Beam Connections

By Elwyn E. Seelye
Consulting Engineer, New York, N. Y.

A METHOD of computing lateral stresses in tall buildings to be satisfactory theoretically must take into account two fundamental facts. First, on account of the rigidity of the floor the lateral shear carried by the several bents is proportional to their relative stiffness rather than to the areas of exposed wall tributary to them. Second, the shears carried by the several columns in a bent are proportional to the relative stiffness of the crosses or tees formed by the intersections of the beams and columns with each other.

Primarily, then, the important thing is to distribute the shears in proportion to the stiffness of the crosses and tees formed by the intersection of the columns and beams. (See Fig. 1.) Theoretically the size of every member in a bent, from cellar to roof, will affect more or less the shear which a given column in a given story will take. However, the following assumptions will not greatly affect the results in a normal case: (*a*) Points of inflection are at midspan, and (*b*) points of inflection remain on a straight line between adjacent panel points.

From Fig. 2, which represents the deflections under lateral load of floorbeams framing into a single column, we may write the following equations:

$$\Delta_1 = \frac{CP_1l_1^3}{I_1} \qquad \Delta_2 = \frac{CP_2l_2^3}{I_2}$$

$$\Delta_3 = \frac{CP_3l_3^3}{I_3} \qquad \Delta_4 = \frac{CP_4l_4^3}{I_4}$$

By moments $P_1l_1 + P_2l_2 = P_3l_3 + P_4l_4$

By similar triangles $\frac{\Delta_1}{\Delta_2} = \frac{l_1}{l_2} = \frac{P_1l_1^3I_2}{P_2l_2^3I_1}$, or, $P_2 = \frac{P_1l_1^2I_2}{l_2^2I_1}$ (1)

Assuming the slopes of successive stories to be equal,

$$\frac{\Delta_3}{\Delta_4} = \frac{l_3}{l_4} = \frac{P_3l_3^3I_4}{P_4l_4I_3}, \text{ or, } P_4 = \frac{P_3l_3^2I_4}{l_4^2I_3} \quad (2)$$

Using these values in the moment equation,

$$P_1l_1 + \frac{P_1l_1^2I_2}{I_1l_2} = P_3l_3 + \frac{P_3l_3^2I_4}{I_3l_4},$$

$$\text{or,} \quad P_1 = \frac{P_3l_3\left(1 + \frac{l_3I_4}{l_4I_3}\right)}{l_1\left(1 + \frac{l_1I_2}{l_2I_1}\right)} \quad (3)$$

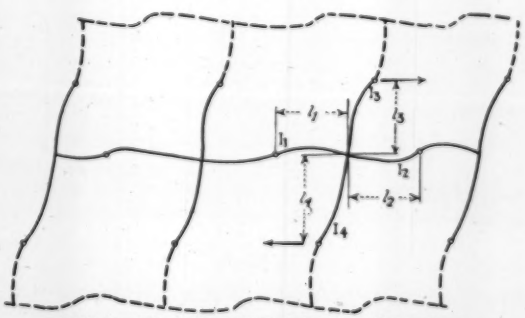


FIG. 1—DEFLECTION OF A WIND BENT UNDER LATERAL LOAD

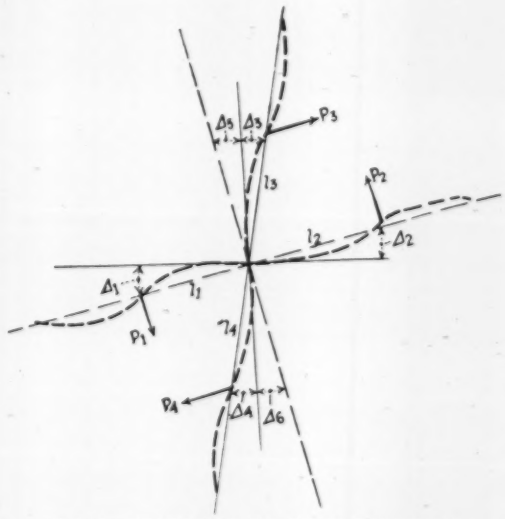


FIG. 2—DEFORMATION OF FLOORBEAMS AROUND A COLUMN

Further, the angle of twist being the same for column and beam,

$$\Delta_5 = \frac{l_3}{l_1}\Delta_1$$

But since

$$\Delta_1 = C\,\frac{P_3l_3\left(1 + \frac{l_3I_4}{l_4I_3}\right)l_1^2}{\left(1 + \frac{l_1I_2}{l_2I_1}\right)I_1}$$

we obtain

$$\Delta_5 = C\,\frac{P_3l_3^2l_1\left(1 + \frac{l_3I_4}{l_4I_3}\right)}{I_1\left(1 + \frac{l_1I_2}{l_2I_1}\right)}$$

from which

$$\Delta_3 + \Delta_5 = CP_3\left[\frac{l_3^3}{I_3} + \frac{l_3^2l_1\left(1 + \frac{l_3I_4}{l_4I_3}\right)}{I_1\left(1 + \frac{l_1I_2}{l_2I_1}\right)}\right] \quad (4)$$

As $\Delta_3 + \Delta_5$ is the same for all columns of the bent, it is possible to write simultaneous equations for P_3 at each panel point in a bent and solve for their relative values.

If we neglect the effect of torsion for the time being, it is evident that $\Delta_3 + \Delta_5$ is the same not only for the different columns in a bent but also for all columns of the story. Therefore we may compute the relative values of the resistance of all columns, and by equating their sum to the total lateral shear above this story (see Fig. 3) we may solve for the actual value of the column shears.

A wind bent is shown in Fig. 4, which will serve to illustrate the method of computing the stresses. It has been assumed that the total shear equals 80,000 lb.; that

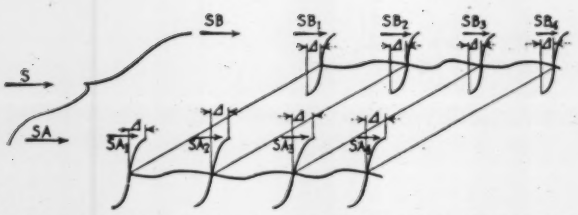


FIG. 3—ALL COLUMNS IN A STORY DEFLECT EQUALLY

$I_1 = I_2 = I_3 = I_4 = 100$ for both exterior and interior panels; and that there is no wind increment on the panel point. Using equation (4) first for the wall cells (for which I_2 is zero) and then for the interior cells,

$$\Delta' = P'_3 \left[\frac{1{,}000}{100} + \frac{100 \times 20 \left(\frac{10 \times 100}{l + 10 \times 100} \right)}{100(l+0)} \right] = 50 P'_3$$

$$\Delta'' = P''_3 \left[\frac{1{,}000}{100} + \frac{100 \times 20\,(l+l)}{100\,(l+l)} \right] = 30 P''_3$$

or $P''_3 = 1.67\ P'_3$;

Therefore $2P'_3 + 2P''_3 = 80{,}000 = 5.33 P'_3$,

or $P'_3 = 15{,}000$

$P''_3 = 25{,}000$

From these values the girder shears are found by moments as given in Fig. 5. It will be noted that the girder shears do not agree. This is due to the errors in the assumptions made in deriving the formula, but the designer would be justified in using the larger of the two values and thus would be on the side of safety.

What is the situation when the interior columns are much larger than the exterior, as is the case in a modern tower building? Let I''_3 and $I''_4 = 1{,}000$, and all other assumptions be the same as for Fig. 4. Evidently the first term of equation (4) would drop into insignificance, and we would have approximately $2.4\ P'_3 = P''_3$, so that $P'_3 = 12{,}000$ and $P''_3 = 28{,}000$. This indicates that the size of column does not greatly affect the shear distribution if the floorbeams remain the same. It also shows how much error may be involved in the practice of assuming that the shears are proportional to the moments of inertia of the columns.

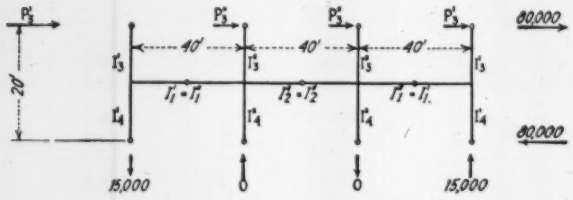


FIG. 4—CONCRETE EXAMPLE OF WIND BENT

If, however, the interior girder size be also increased, increasing I''_2 from 100 to 1,000, we get:

$50\,P'_3 = 4.6\,P''_3$, or nearly $11\,P'_3 = P''_3$

$P'_3 = 3{,}300$ $\qquad$ $P''_3 = 36{,}600$.

In other words, as would be expected, a stiff column does not offer proportionate resistance unless the beams connecting to it are correspondingly stiff.

The above formulas may be used to determine the effect of kneebraces if the lengths used are taken as suggested in Fig. 6.

In Fig. 7 is shown the framing plan of a T-section building. The center of gravity of the cells of resistance may be computed by the above formulas and the distance e determined. Obviously this eccentricity may be resisted in part by a couple acting through stiff bents lying at right angles to the wind, W, but for the present purpose the longitudinal strength is neglected and becomes an additional safety factor.

Assuming the center of rotation at the center of gravity of resistance, if these bents were all at the same distances from center of rotation they would carry the torsion in proportion to their stiffness as determined by equation (4). As it is, they resist torsion in proportion to the product of their stiffness multiplied by their distance from the center of rotation.

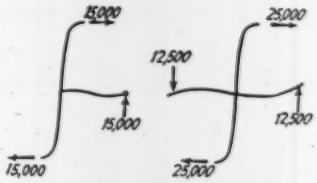


FIG. 5—GIRDER SHEARS OF WIND BENT IN FIG. 4

Assuming further that the relative resistances of these bents be $P_6 = P_5 = P_4 = l/3P_3 = l/3P_2 = l/3P_1$. Then $W = 12P_6$, where P is the direct wind shear. Calling the torsional wind shears on the several bents P'_6, P'_5, etc., the torsional shears will be proportional to the distances from the center of rotation, and the torsional moments will be proportional to the squares of these distances, or,

$$We = \frac{P'_6}{l_6}[l_6^2 + l_5^2 + l_4^2 + 3l_3^2 + 3l_2^2 + 3l_1^2]$$

$$\text{or, } P'_6 = \frac{Wel_6}{[l_6^2 + l_5^2 + l_4^2 + 3l_3^2 + 3l_2^2 + 3l_1^2]}$$

The total loads on the several bents are then easily found, by adding P_6 and P'_6, etc.

When we have designed the bents for the above relative strengths, no bents will be overloaded by a lateral load whose center of gravity coincides with the center of gravity of the exposed surface, but we will not have prevented a warping of the structure due to torsional deflection.

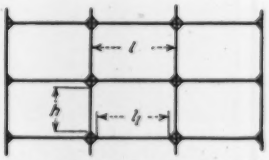


FIG. 6—VALUES OF h AND l WHEN KNEE BRACES ARE USED

To eliminate torsional twist in this particular problem it would be necessary to provide much greater stiffness in the extreme bents of the stem of the T, which would rarely prove economical. However, some

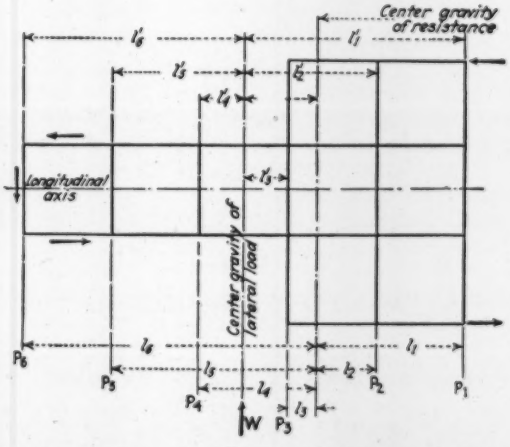


FIG. 7—T-SECTION BUILDING IN WHICH CENTERS OF GRAVITY OF LATERAL LOAD AND OF RESISTANCE DO NOT COINCIDE

such precaution may be necessary in extreme cases. In place of equation (4), a simpler equation which will give approximate results may be used. Referring again to Fig. 1, it is evident that

$$P_3 = \text{lessor of } \left[\frac{I_4}{l_4^3} + \frac{I_3}{l_3^3}\right] \text{ or } \left[\frac{I_1}{l_1^3} + \frac{I_2}{l_2^3}\right]$$

This is simply stating that the resistance will be directly proportional to the moments of inertia and inversely proportional to the cube of the lengths and that the floorbeams on one hand and the columns on the other form two separate links in a chain in which the weakest link will govern.

It is well to remember that the stiffness of the connections is the vital point on which the lateral resistance of a building is founded. The design of these connections is a subject fully as important as the proportioning of the members; and being one where the factors of stiffness, strength, architectural clearances and practical fabrication are all involved, it presents many interesting problems.

Geodetic Survey Develops New Instrument

Vertical Collimator Designed by Instrument Division for Use in Precise Triangulation Surveys

By Douglas L. Parkhurst
Chief, Instrument Division
U. S. Coast and Geodetic Survey

A NEW instrument for taking vertical sights, designed primarily for use with the Bilby steel tower (see *Engineering News-Record*, Aug. 9, 1928, p. 215) in conducting precision triangulation surveys, has recently been developed by the U. S. Coast and Geodetic Survey. It is used to locate the theodolite at the top of the tower, directly over the permanent station mark embedded in the ground beneath. The towers are used in flat or heavily wooded country where it is necessary to elevate the instruments to obtain proper ranges.

There are, properly speaking, two towers at each station, erected one outside the other. The inner tower supports the theodolite and the outer one has a platform for the use of the observer and extends somewhat higher than the inner so that a signal light may be placed on its summit which may be observed from another point of the triangle being surveyed.

A bronze tablet is embedded in natural rock or concrete directly underneath the theodolite, forming the permanent marker of the triangulation station, and it is of course necessary that the theodolite and signal be as nearly as possible directly over this tablet. To accomplish this, the new instrument, which is known as a vertical collimator, has been designed. (See illustration.) It consists of a three-armed leveling head which may be attached to a standard transit tripod. This leveling head has a standard which forms a bearing in a vertical position, and in this bearing is mounted a telescope with a prism introduced between the objective and eyepiece so that the instrument may be read in a horizontal position. The observer looks into the eyepiece in the same manner as he would into the telescope of an ordinary transit, but the line of sight is bent directly upward by means of the prism. A level is attached to the objective end of the telescope, and the entire telescope body may

NEW INSTRUMENT FOR VERTICAL SIGHTING

be rotated through approximately 270 deg. so that the instrument may be leveled easily in each direction.

In use, after the tablet has been located approximately under the middle of the tower, the collimator is carefully centered over the tablet by means of a plumb line and its cross-wires are focused upon a metal plate at the top of the tower upon which the theodolite is to be mounted. This plate is shifted until its center and the intersection of the cross-wires coincide and is then fastened in place. The plate is provided with grooves into which the three leveling screws of the theodolite fit, so that the centering of the instrument becomes automatic. For the locating of the signal light the same general procedure is followed.

The new instrument has an advantage over those formerly used in that it may be mounted rigidly upon the ground and need not be carried to the top of the high tower. The old-style instruments were used on the towers and sighted directly downward, and as there is always a certain amount of vibration, centering of the instrument over the station mark was by no means as easy as centering in the new manner where the instrument itself is fixed. While this new collimator is designed for upward sights only, because of the work upon which it is engaged, it would be a simple matter to adapt it for sighting either upward or downward for use in shaft sinking, mining or city surveying.

National Wealth $3,000 Per Capita

Sixteen years produced a 37 per cent increase in the wealth of the United States, the National Industrial Conference Board estimates. Its figure for 1928 is 360.1 billion dollars ($3,000 per capita), while the U. S. census estimate of 1912 was 186.3 billions; the apparent increase of 93 per cent reduces to 37 per cent when the change in value of the dollar is allowed for. The figures include only physical assets, and exclude credit and currency.

Sanitation in China as Noted by an American Engineer

Observations on General Conditions Affecting Public Health as Judged by Occidental and Chinese Standards, With Notes on Water Supply and Sewerage in Coast Cities

By Harold F. Babbitt
Professor of Sanitary Engineering, University of Illinois, Urbana, Ill.

SANITATION in China, as is the case with many other human activities in that country, is based on entirely different conceptions than those that prevail in the Occidental world. It might be said with truth, from the Occidental viewpoint, that there is very little sanitation in China. The problem of public health and the saving of human life cannot be approached in China in the same manner as in less densely populated countries.

DUMPING NIGHT SOIL IN SEWER AT PEKING

The great density of population, the high birth rate and the frequent and extensive famines would seem to discourage attempts to diminish the number of deaths from disease merely to increase those from starvation and neglect.

Human life is not so highly valued in China as in most other countries. Vital statistics are not available, but the prevalence of communicable diseases is everywhere evident and the rate of infant mortality is probably very high. Only those who have acquired immunity to disease can exist in the midst of such dangers. Water-borne disease is probably uncommon because of the Chinese habit of consuming only hot drinks.

General Sanitary Conditions

Sanitation in China must be judged chiefly by conditions found along the Pacific coast. Access to the interior under the present war conditions is difficult, dangerous or impossible. In view of the dearth of Chinese sanitary engineering works in the larger coastal cities, where foreign influence is felt most greatly, and the indifference of the Chinese to sanitation when not affected by foreign influence, it is safe to conclude that sanitary engineering works are to be found principally in cities in which there is a foreign residential district. The war activities of the past decade have stopped all construction, and the effect of the forces of destruction and decay are widely evident. The present political turmoil is of such intensity that the national government is unable to devote serious attention to public health, and local governments are either uninterested or powerless to do so.

Only one city in China was found which possessed a water-works constructed and operated by Chinese. This is Canton, which is widely known as among the most progressive cities in China. The financial experience of the privately owned water-works in Canton is typical of the threat against the use of private capital in the construction of water-works in other Chinese cities. The Cantonese works were constructed with private capital and were operated under private management until the past year, when they were taken over by the municipal government without compensation to the owners. Peking and Tsingtao are two other cities which now have water-works entirely under Chinese management. The works in both cities were built and operated by German initiative, capital and engineers. The Peking works were obtained by purchase from the original owners. The works at Tsingtao were captured by the Japanese from the Germans during the World War and were later turned over to the Chinese by treaty. Tientsin has water-works, but much of the stock is owned by foreign interests and the operating officials are Scandinavians.

ROADSIDE PUBLIC COMFORT STATION ON A FARM NEAR HANGCHOW
Example of the utilization of organic wastes in China

The shallow private well and the water pedler are important competitors of the public supply, where such ex-

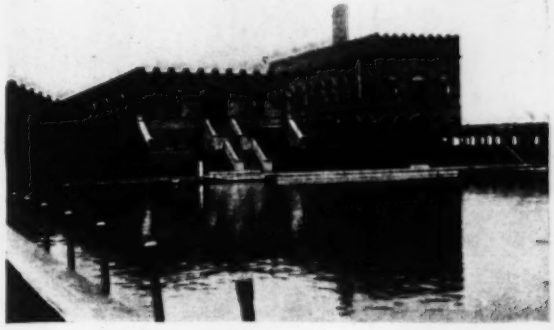
OPEN SEWER NEAR TIENTSIN
Convenient for scavengers if for no one else.

ists, and are the principal providers of water where there is no public supply. The private venders of water obtain their supply from shallow wells, canals, rivers and other surface sources. The condition of the soil in populous communities and the appearance of the water in most canals and rivers would seem to preclude the necessity for a laboratory analysis to determine the potability of the supply. In some cities the water venders coagulate the water with alum to improve its appearance and salability. The sanitary qualities are also probably improved by the process.

Sewerage and Its Lack

There are sewers in nearly all large Chinese cities. Shanghai can boast of three activated-sludge plants. In strictly Chinese cities the sewers have been built and are maintained by Chinese initiative, but there is no city which possesses a complete sewerage system. The existing sewers have been built to drain swampy or inundated districts. Upon the completion of such storm or surface drains they are utilized also for the removal of night soil and other filth. Openings are made at some location which may be convenient or inconvenient according to the point of view. Midden buckets and night-soil carts are brought to these openings and dumped. Many of the sewers are open ditches which serve also as canals for transportation, as a place for the houseboats in which Chinese families exist, and as sources for water supplies.

The habit of conserving, with meticulous care, all inedible organic matter for use as fertilizer minimizes the pollution of surface waters and the load on water-filtration plants. It reduces the organic filth which might otherwise accumulate in populous communities, and it gives a hand-picked and well-swept appearance to the countryside. Few if any streams are polluted with strong, fresh sewage, septic watercourses or concentrations of organic matter going to waste. Sewage and night soil, garbage, dead animals and other organic matter are gathered and saved for use as fertilizer. The concentration of night-soil buckets, heaps of night soil rotting in the sun and sampans loaded with carefully garnered night soil frequently fill the air with noisome and nauseous stenches offensive only to the nose of the unwanted foreign devil. A description of some of the incidents seen in the night-soil industry would be too disgusting for print.



RAPID SAND FILTER PLANT, SHANGHAI

An amusing competition is indulged in by farmers in the environs of Hangchow and probably elsewhere. The competition is devoted to the attraction of the fertilizer-producing abilities of the passers-by. A large earthenware jar is set conveniently to the roadside; a bar of wood is placed as a roost on one side of the jar; and a thatched protection from the sun is placed invitingly over the whole. No protection from the public eye is provided. Nakedness is seen but not looked at in the Orient. No visual sign is necessary to invite the traveler to make use of this comfort station. Its purpose can be detected with the eyes shut.

LAYING A SMALL SEWER IN PEKING

Water-Works of a Half-Dozen Cities

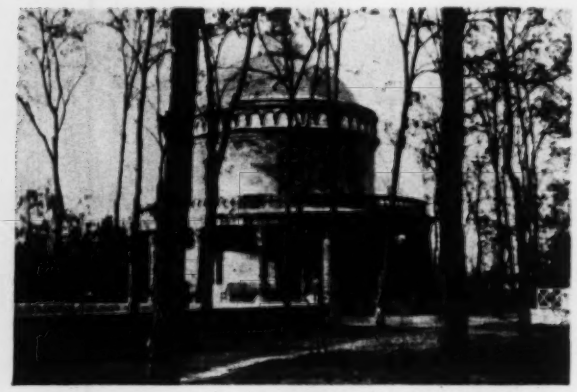
The water-works of a few Chinese cities are the only sanitary works worthy of description. These works are to be found in Tientsin, Peking, Tsingtao, Shanghai, Hong Kong and Canton. As already stated, all, with the exception of Canton, have been constructed by foreign engineers and all but the works at Peking, Canton and Tsingtao are operated by foreigners.

Tientsin—There are two water-works at Tientsin; one under the control of the British Municipal Council, which supplies water to the British and the former German concessions; and the native city water-works, which supplies the French and Japanese concessions and the Chinese city.

The entire built-up area served by the water-works of the British Municipal Council is reached by the distribu-

tion system, to which there were 1,839 service connections at the first of the year 1929, to supply a population of about 39,000. The water supply is obtained from seven wells from 326 to 641 ft. deep, all pumped by airlift, the air being supplied by electric-driven compressors. The quality of the water from the wells is satisfactory. H. W. G. Clark, a member of the American Water Works Association, is water-works engineer.

The native-city water-works of Tientsin takes water from a canal or from the Hsi Ho River, according to the quality of the water in either source. After slow sand filtration the water is chlorinated with calcium hypochlorite and then pumped to the distribution system. The chlorine control is inaccurate and frequent bacterial tests are not made. The average daily water consumption in 1928 was about 455,000 gal. J. Holmberg is engineer-in-chief.



WATER TOWER AT END OF PEKING AQUEDUCT

Peking—The water-works of Peking is privately owned and is operated entirely by Chinese. It serves a relatively small part of the city. The water is taken from the Sim River about 14 miles from Peking, and is filtered through slow sand filters before flowing by gravity through the aqueduct to the high-lift pumping station located just outside of the Tatar wall. The aqueduct consists of two 16-in. steel pipes, twenty years and five years old, both in good condition. During the summer months chlorine is added to the intake reservoir at the high-lift pumping station. The average rate of water consumption is 3,000,000 gal. a day and the water is delivered to about 7,500 families. The general manager of the water-works is G. C. Chau.

Shanghai—At Shanghai there are four water-works: two for the Chinese city, one for the French concession, and one for the international settlement. Each draws water from the Whang Poo River and passes it through sand filters. The Shanghai Water-Works Co., which serves the international settlement, is the largest and best equipped of the four water-works. The average rate of consumption is 42,000,000 gal. per day. The population supplied is uncertain, but it is estimated that the daily per capita demand is 52 gal. In view of the absence of baths in the homes of the Chinese consumers, who are responsible for 90 per cent of the consumption, it is evident that the Chinese are large consumers of water in spite of the fact that 90 per cent of the services are metered.

The purification plant of the Shanghai Water-Works Co. consists of primary settling and coagulating basins, both slow and rapid sand filters and chlorinators. The first slow sand filters were built in 1881 and were the first filters of their type to be constructed in the Far East. The rapid sand filter plant was recently completed and was being duplicated in 1929 to give a total capacity of about 58,000,000 gal. a day. The quality of the water is maintained under laboratory control, within the standards of potability fixed in the agreement with the Shanghai Municipal Council. C. D. Pearson is engineer-in-chief and manager of the water-works.

Hong Kong: Victoria and Kowloon—Hong Kong is a British colony, composed of Victoria, on the island of Hong Kong, and Kowloon, on a peninsula from the mainland. The two cities are separated by a narrow channel. The population of both cities is increasing rapidly. There are six impounding reservoirs and one stream intake on the island of Hong Kong. The total storage available is about 2.5 billion gallons from a catchment area of 3,278 acres. The works should be able to supply 3,600,000 gal. per day by gravity and an additional 5,000,000 gal. by pumping. This is all supplied to the city of Victoria and is inadequate to care for the estimated demands. The existing supply for Kowloon includes three impounding reservoirs and one river intake. The total watershed area is 4,270 acres. The storage capacity is about 0.6 billion gallons. These works are estimated to have a daily capacity of 6,000,000 gal., which is slightly greater than the probable demand in Kowloon in the immediate future. To balance the probable deficiency in Victoria with the slight expected surplus in Kowloon a 12-in. cast-iron pipe was laid across the harbor in December, 1929, to connect the two distribution systems.

All water in the two cities is filtered, partly by slow sand and partly by rapid filters. The distribution systems are of cast-iron pipe and serve practically all built-up districts in the two cities. The extreme shortage of water in 1929, which necessitated the importation of water by boat from Shanghai, has impressed upon the

PUBLIC WATER HYDRANT IN CHINESE PORTION OF TIENTSIN

Filling tin cans for hand delivery of water.

BYE WASH DAM UNDER CONSTRUCTION, KOWLOON, HONG KONG

Water from several impounding reservoirs is let down streams to common intake.

people of the colony the need for greater water resources. Additional supply works are now under construction. When completed in 1932 the combined capacities of the Victoria and Kowloon works will be nearly 20,000,000 gal. a day. R. M. Henderson is water-works engineer.

Canton—There are two water-works in Canton: small works on Shameen Island, owned and operated by foreigners to supply some 2,000 population in the British and French concessions, and the Chinese city works, operated by the municipality. Both draw water from the Pearl (Chukong) River. The Shameen Island supply is drawn from a point opposite the heart of the city where the river is probably much polluted, and passed through rapid pressure filters, without laboratory control. C. E. Watson is director of public works and superintendent of the water-works.

Water for the Chinese city of Canton is taken from the river about 6 miles above the city. It is raised to settling reservoirs by three 6,000,000-gal. electrically driven centrifugal pumps, passed to slow sand filters and is chlorinated with a chloronome apparatus. The operation of the plant is in the hands of competent operators, as indicated by the daily chemical and bacterial reports. The population of Canton is estimated at various numbers from 750,000 to more than 2,000,000. The United States Consulate at Canton estimates it at close to 1,000,000. The Chinese estimate the number of water services as about 38,000 and the daily consumption as 18,000,000 gal. This rate of consumption is increasing rapidly. To meet the overload on the existing works a 5,000,000-gal. rapid sand filter plant is now under construction. Rapid sand filters are under consideration to serve the suburb of Honan across the river from Canton. Dr. Wu Pak Liang is commissioner of public works and two American-trained Chinese are in charge of the water-works. All the rapid filters mentioned in the foregoing paragraphs are of British make, either Paterson or Candy, mostly the former.

The generous consumption of water by the Chinese when it is supplied to them and their utilization of sewers when available indicates an appreciation by the Chinese of sanitary facilities. The poverty of the people, the extensive night-soil industry and the conservation of night soil as an industrial commodity are among the principal causes for the general impression that there is no sanitation in China.

Progress and Results on One of Best Irrigation Projects

DESPITE the low rainfall which characterized the last season in the West Coast region, water-storage conditions on the 21,000-acre Orland reclamation project in California are favorable. An accumulation of 55,500 acre-ft. was in storage Feb. 15 in the East Park and Stony Gorge reservoirs, both being about half full in February. With only a normal March and April rainfall both will reach the overflow point, at which they have a combined storage of 101,000 acre-ft. Natural flow normally supplies the lands until June, after which 3 acre-ft. per acre is required to mature the crops; that amount was available in February.

Orland is one of the projects where landowners successfully option their land to the U. S. Bureau of Reclamation for advertisement and sale with prices predetermined by independent appraisal. Only 45 farms out of a total of 700 are on the market for the 1930 season. Before irrigation the land of the project was valued at $600,000; now it is $6,000,000. The average crop return for the ten-year period ended in 1928 was $50 per acre, more than a threefold increase over pre-irrigation days.

The aggregate cost of the Orland project now amounts to $2,300,000, of which $1,300,000 was for the recently completed Stony Gorge dam. Of the primary building charge of $55 per acre, $31.46 has accrued, and Orland is one of the few projects that has met its obligations as they became due. The remainder will be paid by 1935, when $4 per acre annual installments will be due on the new reservoir, estimated to cost $68 per acre, actual cost somewhat less. Annual operation and maintenance, according to R. C. E. Weber, who has been project superintendent for many years, varies from $1.50 to $1.70 per acre.

Progress on Bonnet Carré Spillway

In view of the interest in the Bonnet Carré spillway and the hearings looking toward a review thereon before the House flood-control committee, the following status of the work accomplished up to the end of January is reproduced from the latest *Progress Report* of the Mississippi River Commission:

Items	Estimated Total Under Contract	Total in Place to Jan. 31, 1930
Common excavation, cu.yd.	400,000	121,485
Levee fill, cu.yd.	75,000	15,412
Steel sheet piling, sq.ft.	600,000	191,496
Wood piling, lin.ft.	750,000	288,260
Class A concrete, cu.yd.	104,000	11,517
Reinforcing steel, lb.	280,000	35,539
Section 1—Lower highland levee, cu.yd.	560,000	62,000
Section 2—Upper highland levee, cu.yd.	400,000	78,000
Section 3—Lower swamp levee, cu.yd.	2,810,000	*421,000
Section 4—Upper swamp levee, cu.yd.	3,780,000	*598,000

*Represents material taken from cutoff ditches.

During January 352,916 cu.yd. was placed in the side levees.

Reservoir Control for Mississippi Suggested by 1927 Flood Data

J. P. Kemper Shows What Storage Would Accomplish in Reducing Flood Peaks at the Mouth of the Arkansas and Eliminating Need for Diversion Floodways

IN A recently completed study of data from the 1927 flood in the Mississippi River, J. P. Kemper, of New Orleans, suggests the possibility of holding back flood peaks by means of reservoirs to such extent as to reduce the greatest floods to the capacity of the improved channel between the Arkansas and the Red rivers. With such control of floods no diversion through the Boeuf valley would be necessary for protection of the Tensas basin.

Curves of 1927 flood flow at the mouth of the Arkansas, reproduced herewith, give the total inflow from the White, Arkansas and Mississippi rivers and the respective amounts that ran off by way of the river channel and by way of crevasses (at Mounds Landing and other points). The levee failures decreased the river runoff greatly. Of the total flood discharge of 167 million acre-feet during the 42-day period considered, more than 50 million acre-feet left the river through the crevasses. With the channel improved by the levee enlargement now in progress, 3 ft. above 1914 Mississippi River Commission grade, the river can carry safely 1,950,000 sec.-ft., which would reduce the 1927 flood excess to 16 million acre-feet (1 sec.-ft. flowing for one day equals 2 acre-ft., approximately). Were detention reservoirs available to hold back, say, 20 million acre-feet, a flood even greater than that of 1927 could be reduced to channel capacity between the Arkansas and Red rivers.

In the Tensas basin region, says Mr. Kemper, the 1927 flood was the largest on record, though upstream, as at Cairo, larger floods than that of 1927 have occurred. An unprecedented volume of discharge from the Arkansas and White rivers was responsible for the record size of the flood at and below Arkansas City.

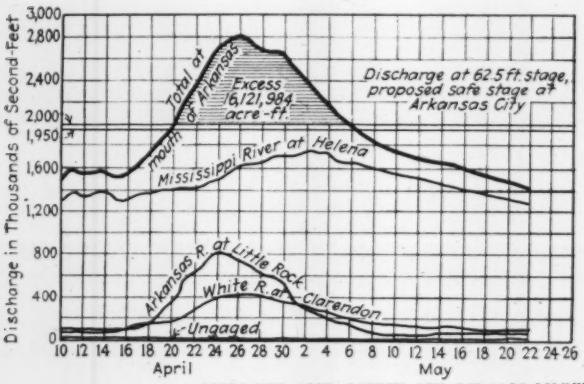
Mr. Kemper deduces from these facts that:

The main problem of the lower river, therefore, is to determine what to do with 20 million acre-feet more water at the mouth of the Arkansas River than the Mississippi River below that point can safely take care of.

It is impossible, with the limited available data, to work out in the office, offhand, the best project to solve this problem. An attempt to hurriedly do that is what led to the collapse of the Jadwin plan. There are too many contingencies, due to collateral problems which are being urged and which in justice should receive adequate consideration.

Certain fundamentals, however, stand out in bold relief as being almost axiomatic. One is that it is not necessary to wreak such enormous destruction as will result from the plan of the army engineers in the Boeuf and Atchafalaya basins, in order to take care of 20 million acre-feet of water at the mouth of the Arkansas River.

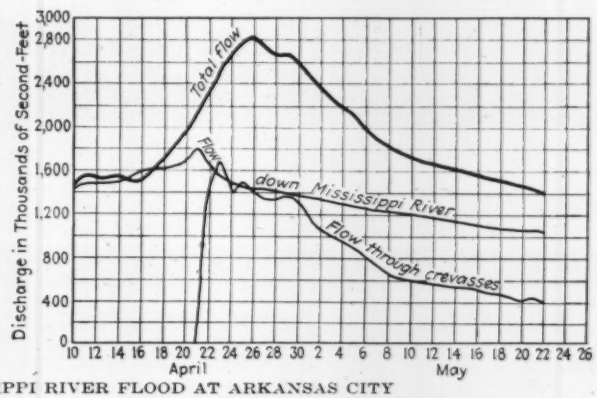
Another is that if this 20 million acre-feet of water can be held back above the mouth of the Arkansas River it will reduce the problem at the mouth of the Red River in practically the same proportion and greatly simplify the problem of the Atchafalaya basin.



INFLOW AND OUTFLOW OF 1927 MISSISSIPPI RIVER FLOOD AT ARKANSAS CITY

DISTRIBUTION OF INFLOW

Contributions to total flow of river at mouth of Arkansas River, and excess of inflow over improved capacity of main river channel below this point, show required storage volume.



DISTRIBUTION OF OUTFLOW

Of total inflow of 167 million acre-feet, 117 million passed down river channel, while remainder went through crevasses. About 8 million came from delta basin storage just above.

Another is that, on its own face, the project at Cairo, by means of the Bird's Point to New Madrid bypass, does not afford adequate protection to Cairo and environs and must be supplemented by some system of retarding whereby the flood peaks at Cairo will be flattened out.

He then asserts that storage is needed on the Ohio and Missouri rivers to provide water for adequate dry-season navigation on the upper Mississippi, the Arkansas, White and other tributaries to control floods. Then he concludes:

All of these problems deserve consideration and should be solved in the order of their merit and feasibility. Long before their solution is completed the surplus of 20 million acre-feet of water at the mouth of the Arkansas River will have disappeared.

All premises considered, the conclusion is apparent that it would be a great economic error to resort to a floodway through the Boeuf or Tensas basin to get relief from a maximum of 20 million acre-feet of surplus floodwater when the desired end can be accomplished simply by the carrying out of worthy and urgent projects farther up stream.

The thing to do now is to immediately bring all the levees up to the new grade and section under the plan of the army engineers, which grade is 3 ft. above the 1914 Mississippi River Commission grade. This additional 3 ft. of levee height will materially increase the interval of frequency of crevasses in the Tensas and Boeuf basins. While the levees are being raised, which will probably require two more years, the work of holding back floods above the mouth of the Arkansas River can be gotten under way.

Economic and Research Problems Discussed by Railway Engineers

American Railway Engineering Association Indorses Plan for Exhaustive Study of Rail in Laboratory and Track—Economic Aspects of Engineering Work Stressed in Many Committee Reports

Engineering News-Record Staff Report

INDORSEMENT of plans for a five-year comprehensive study of rails in track and in laboratory and the publication of important reports on steel rails were the high points of the 31st annual meeting of the American Railway Engineering Association, held at Chicago on March 11 to 13. That the meeting was a success hardly needs to be said, in view of the large attendance and sustained interest. Its proceedings, however, were mainly on a smooth and level plane, with few high points in the way of important technical features and few rough spots in the way of controversy. Discussions and criticisms in the main dealt with relatively minor aspects, a normal condition resulting from thorough consideration of the subjects in committee, also from a knowledge of the vast volume of committee and sub-committee reports to be disposed of in a limited time.

In the secretary's report it was shown that publications accounted largely for an excess of expenditures over receipts. As a remedy for this condition, Louis Yager in his presidential address suggested calling upon the railroad corporations to help in defraying the costs of publication, as had been suggested by the late John W. Wallace when presiding at the first meeting of the association in 1900. All the 27 committee reports, with those of the many subcommittees, had been printed in advance, covering about 1,600 pages. Some of the committees included bibliographies of special subjects, in accordance with suggestions from the board of direction. A revised edition of the "Manual of Recommended Practice" which has been pending for some time was announced as being available for distribution.

Moving pictures of track work in Japan, provided by courtesy of the Japanese Government Railways, were displayed one evening and were followed by views of places in Japan visited by the delegates to the international engineering congress at Tokyo last year. At the annual dinner, with nearly 900 persons present, two addresses were given: one on railroad consolidation by Charles Donnelly, president of the Northern Pacific Railway, and the other on the new industrial revolution by Prof. G. W. Dyer, of Vanderbilt University. Mr. Donnelly believes that the Interstate Commerce Commission plan of railroad consolidation has no finality, that consolidation will go on along natural lines with the railroads taking the initiative.

The attendance at the convention was a little less than that last year, with 935 members and 376 guests, a total of 1,311, as compared with 1,403 last year.

Officers for 1930 include: president, George D. Brooke, general manager, Chesapeake & Ohio Railway; vice-presidents, L. W. Baldwin, president, Missouri Pacific Lines, and J. V. Neubert, engineer of maintenance-of-way, New York Central Railroad; treasurer, A. F. Blaess, chief engineer, Illinois Central Railroad; secretary (re-elected), E. H. Fritch, Chicago. New directors are G. W. Harris, C. R. Harding and C. R. Knowles. The association now has 2,856 members.

Rails and Rail Joints

A development of far-reaching importance in rail investigation is promised by preliminary arrangements for a five-year study, announced by Earl Stimson, chairman of the rail committee. The plan proposes a comprehensive and co-operative study by the railways and the rail manufacturers covering a certain tonnage of rails each year, the greater part to be laid in track and subjected to close observation and tests, including the Sperry detector for transverse fissures. A small percentage of each rolling would be set aside for laboratory examination and tests, which will probably be carried out under the direction of Prof. H. F. Moore, of the University of Illinois. The cost is estimated at $50,000 annually, half of which it is expected that the manufacturers will pay. On motion of D. J. Brumley a resolution was adopted requesting the American Railway Association to approve the project and to appropriate a similar sum.

The rail committee's report contained its annual record of rail failures and transverse fissures, showing that the failures of rails rolled in 1923 numbered 114 per 100 miles of track in 1928, as compared with 110 and 98.9 failures for 1922 and 1921 rails in 1927 and 1926 respectively. A better record of 1924 rails is expected, but the curve of failures is not encouraging, according to the committee, no decrease being indicated.

Transverse fissure failures numbered 5,458, an increase of 465 over 1927. Rails rolled in 1917 and 1926 show the greatest number of such failures per year, but those of 1928 have a better record, which, the report states, appears to be the result of changes in mill practice.

In view of the increasing use of intermediate-manganese steel rails, the committee was asked to consider changes in the open-hearth rail specifications of 1925. In reporting on this the committee stated that no change is necessary, simply a modification to allow for the increase in manganese and decrease in carbon. Otherwise the specifications will cover rail contracts adequately. About 400,000 tons of these manganese rails are in service, with generally favorable results. The committee believes that it is only a matter of time before intermediate-manganese rail will supplant ordinary open-hearth rail. Heat-treated rails are showing good results in the track and one manufacturer is now equipped to do heat treating on a commercial basis. The service evidence to date is not, however, considered conclusive.

The rail committee report included three individual

papers: "Economic Selection of Rails," by A. N. Reece, Kansas City Southern Railway; Part IV of a previous paper entitled "Rail and Wheel," by W. C. Cushing, Pennsylvania Railroad; and "Strain Gage Tests on Track Bolts," by E. W. Caruthers, Pennsylvania Railroad.

The work of the Sperry transverse-fissure detector car was reviewed by C. W. Gennet, Jr., with the aid of moving pictures. He gave the expectancy as one fissure for every 10 miles of track. That traffic is the main agent in developing these fissures is indicated by tests on 350 miles of double-track where one track carried three times as much traffic as the other and had seven times as many transverse fissures as the track with one-third the traffic.

Rail joints, including their design and their relation to the track structure, were the subject of the fifth progress report of the special joint committee on stresses in railroad track, which formed a book of 270 pages. The report was presented in summary form by Prof. A. N. Talbot, who in expressing his personal views stated that he favored a shorter angle bar of increased section. In the discussion it was noted that the battering of rail ends usually is considered in relation to rail deflection, but in answer to a question by C. C. Cook, Professor Talbot replied that battering probably would be increased if the joint was arched or had an upward deflection.

Other Track Matters

Lack of collaboration of subcommittees was indicated by the report of the committee on ballast, which proposed to substitute the term "prepared gravel" for "washed gravel," but also included specifications for "washed gravel." However, the association voted to adopt the new term and the committee will revise the specifications accordingly. It was also voted to remove from the manual a list of ballast materials in assumed order of merit. Sharp attack was made on a proposed definition of "ballasted track" as being both incorrect and inadvisable. It was referred back to the committee. A recommendation of the committee on ties that both switch ties and crossties should be renewed individually was adopted. Last year the committee was requested to reconsider the advisability of renewing switch ties by sets, but further study has confirmed the committee in its original opinion. A modification of the so-called Yager traffic-unit formula for comparing the life of ties was adopted for the manual after some discussion. Inspection of ties for acceptance is still lax and the report stated that ties of low grade will be produced as long as the railways accept them as good standard ties.

Plans and specifications for track tools (picks, bars, gages, etc.), as submitted by the committee on track, were adopted for the manual, together with some new switch and frog plans, including a switch for use in paved track. Corrosion of rails and fastening in tunnels is considered negligible for lengths up to 1,000 ft., but heavy in steam-operated tunnels more than 2,000 ft. long, unless special drainage is provided. Drainage and oil coatings are recommended. Information was submitted as to oiling rails on curves to reduce wear and as to remedying the corrosive effect of brine dripping from refrigerator cars, but the latter subject depends upon action by the mechanical division of the American Railway Association.

Concrete roadbed, paving for grade crossings, deformation of roadbed, the use of chemicals and burner for killing weeds, and calculations for waterway openings were all reported on by the committee on roadway. As weed-killing chemicals are usually poisonous, the posting of notices to warn farmers when this work is being done was suggested by E. E. R. Tratman, who also suggested that it is not desirable to have flangeways at road crossings formed simply by the passage of wheels. He thought the report should state that the flangeway should be somewhat deeper than the rail head. Specifications for corrugated sheet metal culvert pipe were submitted and were adopted for the manual.

Bridges and Structures

The new specifications for steel railway bridges, prepared jointly by the committee on iron and steel structures and a committee of the American Society of Civil Engineers, are now in the hands of the former for consideration, but were mentioned only thus briefly in its report. A revision of bearing value for large rollers (that is, the heels of rolling bascule bridges) was adopted for the manual. Information was given as to the extending use of copper-bearing steel and as to longitudinal forces and impact in relation to bridges, together with an abstract of the British committee's report on bridge stress, but it was pointed out that this had little bearing upon American bridge design.

The committee reported that there is increased use of copper-bearing steel for various industrial and structural purposes; in many instances it has been found to last 1½ times as long as ordinary steel. During 1928 and 1929 at least three of the large railroad systems specified and purchased such steel for railway bridges and it has been used for five years in important highway bridges, but the time is not sufficient to determine comparative results. Its use is extending to roof trusses in engine houses and shops that are exposed to marked corrosive influences; also for footbridges over railway yards and for turntables. It can be secured readily at a slightly increased cost. The committee reported that the American Society for Testing Materials has revised its specifications for steel for bridges and buildings to provide for the use of copper-bearing steel when desired by the purchaser.

As a preliminary to preparing standard plans for wooden highway bridges over railway tracks, the committee on wooden bridges and trestles submitted a tabulation of the practice of 31 state highway departments in the design of wooden bridges; their floor construction includes concrete slabs, laminated timbers and plain planking. Advantages of standard designs in the economic use of timber were outlined by C. J. Hogue, of the West Coast Lumbermen's Association. An appendix to the report by A. B. B. Harris described a modified type of open-deck timber trestle having precast concrete caps, fire stops and end bearings, but apparently no structures of this type have been built.

Revised tables of volume and specific gravity of creosote oil at different temperatures, as submitted by the committee on wood preservation, were adopted for the manual. Ties treated with creosote-petroleum mixtures are reported as giving satisfactory service. Progress records were given of test ties in track and test piling in sea water.

Chairman Burton, of the tie committee, in commenting on report on the use of steel ties in India, printed in the committee's report, stated that due to relatively high cost of steel ties in this country as compared with wooden

ones it was hopeless to expect steel ties to be able to compete with them in the matter of annual cost so long as the relative cost does not change much.

Destructive Attacks on Timber

Activities of termites (white ants) in attacking timber structures were reported upon at length by the committee on wood perservation. For some unknown reason these destructive insects appear to be very active just now, having reached what might be termed an epidemic stage in California. The committee has had the co-operation of Thomas E. Snyder, of the U. S. Bureau of Entomology, and Prof. S. F. Light, of the University of California, in its work and was able to present valuable data upon the habits of termites and means of checking their operations. Copies of Circular 314, "Termites and Termite Damage," University of California, and of the report on the symposium on termite problems, Termite Investigation Committee, San Francisco, were distributed to those interested and an excellent motion picture of termites in action was shown.

Masonry Structures

Specifications for girderless flat-slab concrete structures carrying locomotive loading, as prepared by the committee on masonry, were adopted for the manual, having been submitted formerly as information.

Numerous cases of defective concrete and their causes were reviewed, but the committee expressed its opinion that concrete properly made will meet all requirements; defects and disintegration may be attributed usually to materials, to methods of construction or to service condition. A warning was expressed by Professor Talbot as to a statement in the report which implies that considerable additional strength of concrete may be obtained by a longer mixing period, an idea not supported by experience, in his opinion.

An appendix to the report dealt with tests on the bearing power of soils and presented the conclusions that various strata when under load act as a series of plates or slabs, that the bearing power of any stratum depends partly upon that of the stratum below it, while ultimate settlement under a definite load is a direct function of the initial deflection.

Specifications for materials and equipment for railway buildings were adopted for the manual as submitted by the committee on buildings to supplement similar previous specifications. Designs for pump houses and water-treatment plants were also submitted, together with information as to methods of appraisal for fire losses. The committee on shops and locomotive terminals presented a review of engine ashpits, which was adopted to replace matter now in the manual.

Yards, Stations and Water Service

Increasing use of car retarders or track brakes to replace car riders or brakemen in gravity switching was reported by the committee on yards and terminals to have caused important changes in both the hump grades and the yard track layout, the latter change being largely in an increased number of ladder tracks for a given number of body tracks. Other subjects were the provision of automobile parking facilities at passenger stations and the effect of motor truck service on freight station design. The latter effect has been only in requiring greater width of driveways, except where use of the container system has necessitated special facilities for handling containers.

A long series of reports by the committee on water service and sanitation included specifications for laying cast-iron pipe. These were recommended for the manual, but sharp discussion ensued between those who considered it desirable to lay out a definite grade or profile for a pipe line and those (including the committee) who consider this unnecessary, the pipe being laid more or less in accordance with the profile of the ground. Another dispute arose as to whether the "grade line" is the profile of the trench or the hydraulic grade. Various other features entered into the discussion, and finally this part of the report was referred back to the committee. Other parts of the report dealt also with zeolite, barium, lime and other treatment of water for locomotive boilers; the handling of drinking water for trains, and the storage of water at water stations by tanks, standpipes, sedimentation basins and reservoirs.

Highway Safety

Attention of the convention was called to the need for adoption of uniform crossing signals and for education of the public as to what the various types of signs, such as the approach warning sign, mean. In some states railroad officials are attempting to get questions regarding such signs included in the examination for auto licenses. The third conference on highway safety, to be held in Washington the last week in May, is expected to adopt a number of standard signs and signals.

In presenting its report of the committee on signals and interlocking, adherence to the present standards for highway crossing signals was urged strongly by A. H. Rudd of the Pennsylvania, since uniformity is desirable in the interests of safety, while there is a tendency for public authorities to introduce various special designs.

From a study of the use of center columns for railway bridges at highway underpasses the committee on grade crossings reports that they have been used to a considerable extent, particularly in large cities, and that objections to them, especially in rural sections, are due largely to early installations which do not give adequate safety for highway traffic. On two-lane roads, center columns are not likely to be economical, while they create a hazard for both two-lane and three-lane roads. But on a four-lane road they may be used with safety, providing the minimum width of each passageway is 20 ft. Adequate safety can be provided by: (1) sufficient width of roadway, (2) separation of opposing lines of traffic into two definite lanes, (3) proper sight distance and alignment of the highway, (4) proper warning lights and reflectors, especially in rural districts.

From the standpoint of economy and good railway practice there is no doubt of the advantages of center columns, as this arrangement in most cases makes practicable a deck structure of steel or concrete which in cost compares favorably with an equivalent through bridge. For the railroad, a deck structure is desirable, as it allows a more flexible track layout and requires no spreading of track centers where two or more tracks are involved. Whether to use sidewalk columns in addition to center columns depends upon so many factors that no definite statement can be made.

A recommended sign of "Flagman Off Duty," to be displayed when a crossing watchman leaves his post, aroused considerable discussion as to whether it should be used and how it should be displayed. Motions to refer the matter back to the committee were defeated and finally the recommendation was adopted. In its support a representative of the Wisconsin State Highway Commis-

sion stated that a large proportion of accidents at watched crossings occur when the watchmen are absent. An automobile driver seeing a watchman's cabin and no danger flag displayed is likely to assume that he is authorized to proceed.

Train operation governed by signal indications instead of train orders and timetables was reported as making marked progress, being now in service on 1,648 miles of line. The economic value of signaling in saving time and fuel and reducing operating expenses is said to be even more important than its value in increasing the safety of operation.

Cost Accounting

A comparison of the Interstate Commerce Commission's orders of 1926 and 1929 as to depreciation charges, presented in the report of the committee on records and accounts, started discussion on this vexed subject which indicated the difficulties but offered no help of a constructive character. The committee gave in full, but without comment, the report by Mr. Eastman, of the Interstate Commerce Commission, on the revision of accounting rules. As to changes in physical and valuation records to accord with government regulations and to effect greater simplicity, the committee submitted a revision of the 1928 forms, but concludes that the various methods and forms have not been tested sufficiently to warrant the adoption of any particular set. Records of grade crossings were given, including the system of the Connecticut Public Utility Commission, also an outline of contracts and accounting for industry tracks.

Legislation governing the licensing and registration of engineers, architects and surveyors was the main subject of the report of the committee on rules and organization. From a comparison of the laws of several states the committee considers that there is real need for a uniform law. The report was accepted without discussion. For construction contracts, the committee on uniform general contract forms reported that the cost-plus-fixed-fee system is not used generally by railways and is advisable only with contractors of known reliability, the cost-plus-percentage contract being generally preferable. This committee submitted forms of agreement for wire-line crossings, industry tracks and joint passenger terminals, the last for discussion only and the others for inclusion in the manual. Agreements for wire crossings were presented also in the report of the committee on standardization. A large report of this latter committee reviewed developments in standards and the use of the A.R.E.A. "recommended practice." In presenting the report, W. C. Cushing stated that plans are being completed for financing the American Standards Association which will provide for a broadening of its work, while a connection with the International Standards Association is being considered.

Diagrams for clearances on electrified lines with third-rail and overhead wire conductors were submitted by the committee on clearances and were accepted as information after some criticism as to their being indefinite. A tabulation of actual clearances on numerous electric lines was included in the report of the committee on electricity. The new committee on rivers and harbors submitted digests of practice of different railways in levee construction and preventing erosion on riverbanks, together with specifications for levee work and dredging.

Allowance for swell in scow measurement, as adopted for the manual, include 0 to 5 per cent for hardpan and sand, 5 to 10 for sand and gravel, 10 to 20 for clay and hardpan, and a maximum of 30 per cent for ledge clay or stiff mud. Other items adopted include: (1) allowable overdepth in dredging of 1 ft. in hard material and 1 and 2 ft. for channels in sand and in soft material less than 24 ft. and more than 24 ft. respectively: (2) methods of taking soundings, and (3) side slopes of 1 on 2 to 1 on 5 for deep waterways. General information submitted by the committee on electricity, which is now practically identical with the electrical section of the American Railway Association, included: (1) a review of recent waterpower developments, (2) a study of inductive interference on electrified lines of the Pennsylvania Railroad, (3) a tabulation of clearances on electric lines, and (4) floodlighting for railroad yards.

Economic Aspects of Railway Work

Methods and formulas for use in selecting the type of electric locomotive to perform a specified service were submitted by the committee on economics of railway location and were adopted for the manual, as was an outline of the organization of engineering parties on location and construction work. In a section of the report which dealt with the relative merits of grade reduction and heavier locomotives for handling increased tonnage, the committee expressed the opinion that the practice of increasing the weight of engines without thorough study of the alternative of reducing grades is costing the railroads vast sums of money. In discussing this part of the report, C. A. Morse predicted that the next 25 years will see a great amount of grade-reduction work done as a means of effecting economy in railway operation. A progress report on train resistance as affected by stiffness of rails was in line with Mr. Reece's paper on the economic weight of rail, which accompanied the report of the committee on rail. A method of comparing the economics of flat and hump switching, submitted by the committee on economics of railway operation, was adopted for the manual. Progress reports included the dispatcher-control signal system as a means of increasing traffic capacity; the comparative merits of water stations and large tenders; the use of radio telephones in yards and on freight trains; and the effect of bus service on branch line operation.

Human economics, or the value of training individual workmen in order to increase quantity or quality of output, was an important subject in the report of the committee on economics of railway labor. In this direction the railways are far behind the large industrial corporations, which train their employees not only as craftsmen but also as supervisory officials. The only move of the railways in this direction is the apprentice system in the shops of the mechanical department, and even there the training does not extend beyond the apprenticeship period. A different aspect of the same subject was the use of college-trained men for engineering and maintenance work. The conclusion was that modern conditions demand such men in railway service and that special training must be given them, but that the railways must offer sufficient inducement for them to remain in the service. As yet, however, the railways have been slow to realize the advantages of systematic employment of engineering graduates. This subject was covered also in the brief report of the committee on co-operative relations with universities. This report stressed the necessity for improved methods of building up railway personnel and the necessity for better-trained men in railway service. In presenting the report, R. H. Ford stated that some advance is being made on these lines.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

German Ways With Bridges

REVIEWED BY O. H. AMMAN

Chief Engineer of Bridges Port of New York Authority, New York City

DES EISENBAU-I—Von Martin Grüning, ord, Professor an der Teknischen Hochschule zu Hannover. Erster Band. Grundlagen der Konstruktion, feste Brücken. Berlin: Julius Springer. Cloth; 7x10 in.; pp. 441; 360 illustrations. 48 Rm.

TO A FAIR number of books dealing with structural steel design there has been added another volume which is well qualified to acquaint the student with a variety of viewpoints and practices, including those in other countries. The author of Der Eisenbau-I states that his volume is intended mainly as a guide for the student and that he confined himself accordingly to the basic elements of design and to immovable bridges which lend themselves best to a systematic analysis. For a full understanding of the book a thorough knowledge of the theory of stresses is required. The material presented is arranged in a clear and concise form and the author has well succeeded in his efforts to adapt the subject to the particular needs of the student. The book will also be of value to the practicing engineer who is interested in German ways of design and construction.

In the first part of the book the author describes and discusses the basic elements of building materials, permissible unit stresses, make-up of sections, splices and connections, the knowledge of which is essential for the structural engineer. Attention is called especially to the chapter on the factor of safety in internally statically indetermined systems. In the second part of the volume the author describes immovable bridges and gives to the student a clear conception of the use of the basic knowledge. Here he treats, in separate chapters, the various parts of bridges according to their function, such as floors, main trusses, bracings and bearings. The description is concise and brief, giving, together with a great number of detail drawings, a good outline of the fundamental principles in bridge building. For a more detailed discussion of the problems presented special publications on the various subjects must be consulted.

Special attention is called to the chapter on suspension bridges, in which the author gives a method of computing the stresses for this type. A considerable knowledge of mathematics is required to follow the author's analysis, which is somewhat lacking in clarity. The resulting formulas are in no way simple, in spite of the numerous simplifications used in their derivation. The author does not seem to realize the great amount of work which would be necessary to compute the stresses in a suspension bridge according to his formulas. His theory is especially burdensome in the case of tentative studies in which frequent changes in proportions may have to be made. While the discussion is of interest from an academic point of view, it is the writer's opinion that other methods used in the design of suspension bridges, particularly those common in this country, are better adapted to practical use.

The printing is excellent and the value of the book is greatly enhanced by the large number of detail drawings which are presented with remarkable neatness and accuracy, thereby helping the reader considerably in following the author's ideas.

Professor Grüening intends to add to the present publication a second volume on the same subject to be published in the course of this year. Both will be part of a series of "handbooks" for civil engineers, consisting of 28 volumes issued by Robert Otzen and published by Julius Springer, Berlin.

American Business Since the World War

AN AUDIT OF AMERICA: A Summary of Recent Economic Changes in the United States—By Edward Eyre Hunt. New York and London: McGraw-Hill Book Co., Inc. Cloth; 5½x8 in.; pp. 203. $2.

EDUCATION of the public, we are told, must be the chief prop of democratic government, and in this economic era such education obviously must be directed largely toward a more widespread and intelligent understanding of the facts and processes that govern our economic life.

One of the most prolific if not the most effective agencies of such education is the flood of analyses and reports issued under governmental and commercial auspices. Unfortunately few such documents obtain wide reading and therefore fall that much short of their potential usefulness. Much of this disability, of course, is inherent in the nature of the subject. Facts, baldly presented, are at best ill adapted to catch the popular fancy. Economic facts, especially when served raw, fail to tickle the palate of Demos in competition with the more spicy diet provided by the daily passing show and prepared by skillful cooks who know how to cater to the popular taste.

But aside from the intrinsic flatness of economic data, they suffer much for want of effective presentation. A little thought devoted to the humanizing of facts and the dramatizing of processes can help a lot in stimulating a broader interest and understanding with respect even to the cold realities of economic life.

Last May appeared a report on Recent Economic Changes in the United States, based upon a survey made for a committee of the President's Conference on Unemployment by the National Bureau of Economic Research. In this two-volume work a valiant attempt was made to breathe life and interest into the subject, with noteworthy success. Among the many reports dealing with various aspects of modern economic developments, this effort shines out like a good deed in a naughty world.

Despite this, however, it must suffer from obvious handicaps in the competition for public attention. Such a disability must attach to almost any report in two volumes. And of necessity the two volumes must bristle with cold facts, cold figures, charts and tabulations that have little lure for the general reader, even for the business man who is presumed to take more than the normal interest in the subject.

Now comes Mr. Hunt with his little book of 184 pages

in convenient size, in which he has prepared a summary and digest of the report on Recent Economic Changes.

Surely now there can be no excuse for the average American, truly interested in the basic factors of our economic developments, remaining in ignorance of this significant study. Mr. Hunt is well qualified to undertake the exacting task he has performed so admirably. As secretary of the original committee and editor of its report, he has an intimate and first-hand knowledge not alone of the subject matter but also of its many-sided significance. In a style that is crisp to the point of being telegraphic and yet easy to read, he has marshaled the substance of the report in his swiftly moving pages.

Naturally he has been unable to go into detail. The reader who would have more information as to sources and as to the details upon which he has based his sweeping statements, who would check for himself the charts, diagrams and tables that elaborate his data, must consult Recent Economic Changes. But such consultation will be the more fruitful after a reading of Mr. Hunt's book; and we suspect that even the expert, to whom the original report may be more attractive than to the average man, will find An Audit of America a helpful prelude to a more detailed study of the report.

In his compact chapters Mr. Hunt summarizes the findings of his committee as to modern standards of living, the changes that have taken place in the industrial structure (in connection with this he devotes a special chapter to the construction industry), the new problems developed by modern marketing requirements, the status of labor and of the farmer, the movement of credit and money, and the distribution of the national income—surely an extraordinary and helpful bird's-eye view of the present economic scene. And after a couple of hours with Mr. Hunt's book we lay it down with a sense of having enjoyed an interesting visit with a man who knows his subject thoroughly, who sees its many facets in the light of a well-balanced judgment and, above all, who knows how to tell its story swiftly and vividly.

Altogether we should place An Audit of America high on the list of "must" books for the busy man who wishes a broad understanding of what has taken place in American business since the war and of the factors that affect our current business progress. It is good medicine for any of us and mighty easy to take.

Concrete Design in the Navy

STANDARDS OF DESIGN FOR CONCRETE—United States Navy Department, Bureau of Yards and Docks, Washington, D. C. Paper; 6x9 in.; pp. 216; line cuts and charts.

THE new Standards of Design for Concrete (3Y*b* superseding 3Y*a*), issued by the United States Navy Department, bureau of yards and docks, comprises an excellent treatise on concrete as well as a guide for the concrete designer. Modern thinking is reflected in the data given, particularly in regard to unit stresses and designing for continuity. These standards have the virtue of being less of a compromise than some others now in force because they represent individual rather than group thinking. They were written by Lieut.-Commander Ben Moreell, Civil Engineer Corps, United States Navy.

In a preface Admiral L. E. Gregory, chief of the bureau of yards and docks, stresses the departure in these standards from the use of conventional bending moment coefficients for continuous beam design. To replace these coefficients, diagrams showing bending moments and shears in continuous beams and continuous frames are given. A design method for circular reinforced-concrete tanks is an innovation. Torsional stresses in concrete beams are considered, and design procedures for flat slab structures, reinforced-concrete chimneys and slabs reinforced in two directions are given in detail. The arrangement of the "standards" and its complete index should make it valuable for reference purposes.

First of a Triology

THE DANCE OF THE MACHINES: The American Short Story and the Industrial Age—By Edward J. O'Brien, author of "The Advance of the American Short Story." New York: The Macaulay Co. Cloth; 5½x8 in.; pp. 274. $2.50.

POSSESSED by the idea that machines are wrecking mankind mentally and morally, if not physically, the author of this book has projected a triology. The present volume is designed "to show how the machine has so far influenced life and art"; the second, Mechanistic Structures, "to show how large organized masses of human beings are tending to become more and more like machines"; and the third "to propose the necessary means of gaining control" of the machine before we all become its "slaves" and "to suggest a practicable method of applying these means." The effect of the machine age on the short story does not figure as much in the present volume as might be expected from the sub-title of the book. Had the author given the machine due credit for improving the conditions of life, his indictment would have more weight, but that is rarely the way of would-be reformers. There is enough force in what is in the first volume, unbalanced as it is, to make one look forward to the further exposition of the evil of the machine in the author's second volume, and to have still more interest in whatever plan he may propose to prevent man from being crushed under what he considers to be the juggernaut of the Western world. Meanwhile for those who are apprehensive yet wish to read both sides of the case we commend Stuart Chase's Men and Machines, noticed in these columns Sept. 19, 1929, p. 469.

More Mathematics Than Poetry

POETRY AND MATHEMATICS—By Scott Buchanan. New York: John Day Co. Cloth; 5½x8 in.; pp. 197. $2.50.

TO THOSE readers who combine a fairly complete familiarity with mathematical processes and a critical appreciation of literary form and structure, Poetry and Mathematics will bring several evenings of wholesome enjoyment. In a rather good-humored but intensely analytical fashion the author delves into the various attempts that have been made since classical times to deal with ideas by means of symbols. In analyzing the two paths along which these attempts have developed, mathematical symbolism and poetical symbolism, he finds that they reveal parallel developments in human culture.

The idea is set forth very clearly in a list of chapters each dealing with a single step in the historical development of mathematical processes, and each chapter discussing the type of poetic structure corresponding. One example of the method will suffice:

A very close relationship can be discovered between the underlying philosophy of the mathematical procedure of ratio and proportion and that of all figurative or metaphorical writing. Indeed, the author points out that language of any sort is essentially metaphorical, in that

there is an implied relation between a word or phrase and the mental conception from which it arises and which it purposes to reproduce. More specifically, an allegory can be shown to be an equality of relationships between the characters and situations under discussion on one hand and a set of characters and situations envisioned by the reader on the other.

In general, poetry and mathematics have been chosen as the more formal parts of literature and science respectively, and have been treated both separately and in combination. Such treatment has resulted in a philosophy of mathematics and a theory of literary criticism.

For the benefit of some possible readers it may be said in conclusion that the book contains more on mathematics than on poetry.

Forests and Forestry

FORESTS AND MANKIND—By Charles Lathrop Pack and Tom Gill. New York: The Macmillan Co. Cloth; 6x8¾ in.; pp. 248. $3.

HERE is a story of trees and forests from the human, economic and forester's viewpoints, simply and interestingly told. Among the subjects taken up are forests of long ago and of the world today, our national forests, insects and fires as forest enemies, the war against wood waste, and forest industries. The book is well illustrated by drawings and by handsomely reproduced and printed halftones. It should appeal strongly to the many who are interested in forests from whatever viewpoint, but obviously is not designed for the trained forester except as it will serve as a model of popular exposition.

Combining Physics and Mechanics

AN INTRODUCTION TO MECHANICS—By J. W. Campbell, Ph.D., Professor of Mathematics, University of Alberta. New York: Houghton, Mifflin Co. Cambridge, Mass.: The Riverside Press. Cloth; 5x8 in.; pp. 384; 154 line cuts. $3.50.

NUMERICAL TABLES of Hyperbolic and Other Functions—By J. W. Campbell, Ph.D., Professor of Mathematics, University of Alberta. New York: Houghton, Mifflin Co. Cambridge, Mass.: The Riverside Press. Cloth; 5x8 in.; pp. 76. $1.25.

A NEW approach to the method of teaching mechanics characterizes the first of the books listed just above. By combining explanation of the elementary theories of physics with the development of the fundamental principles of mechanics the author hopes to teach the student to analyze problems instead of blindly applying a set of mathematical formulas that he does not understand. Calculus is used from the very beginning, which is an innovation. The book is an outgrowth of experience in teaching mechanics to students in the junior years of applied science and covers a two years' course. The companion book, "Numerical Tables of Hyperbolic and Other Functions," has been prepared by the author and is referred to frequently in the second part of the mechanics textbook.

A Contribution to Hydraulics

THE FLOW OF WATER IN RIVETED STEEL AND ANALOGOUS PIPES—By Fred E. Scobey, Senior Irrigation Engineer, Division of Agricultural Engineering, U. S. Bureau of Public Roads. Paper; 6x9 in.; pp. 136. 30c, from Superintendent of Public Documents, Washington, D. C.

A STUDY of the data obtained from 1,178 experiments on the friction losses occasioned by flow through steel pipe lines, including 98 new tests made by the division of agricultural engineering under the supervision of the author. A new formula is developed for friction loss, of a type similar to the Williams and Hazen formula, with evaluation of coefficients corresponding to six different classes of steel pipe. The coefficients developed are further modified to include a factor representing the effects of age on the carrying capacity of the line. The effects of temperature, acting through variation in viscosity, are included in the study, and an expression is developed whereby they might be taken into consideration in the computation. Of two appendices, one gives abstracts of descriptions of experiments by other agencies than the one represented by the author; the other is a bibliography with 184 entries of the literature cited in Mr. Scobey's bulletin.

British Municipalities

THE MUNICIPAL YEAR BOOK: 1930—Founder and Director: Sir Robert Donald, G.B.E., LL.D.—Edited by Edwin C. Fairchild, with a Preface by Rt. Hon. Arthur Greenwood, M.P., Minister of Health. London: The Municipal Journal, Ltd., Sardinia House, Sardinia Street. Cloth; 6x9 in.; pp. 1135; tables.

EVERY year of the thirty-odd since this annual was first published has added to its size and usefulness. It combines an exhibit of municipal activities and a directory of councilmen and administrative staff for each local government area in Great Britain and Ireland with readable summaries of the year's progress in various municipal services and statistical exhibits, by municipalities, in many fields. Latterly, directory information for privately owned utilities has been given. These indicate only a part of the contents of a volume that must be almost invaluable to thousands in Great Britain and is of great interest to those concerned with municipal affairs elsewhere. A notable feature of the 1930 issue is a section of 59 pp. on legislation in 1928 and 1929 affecting local government, much of which is of far-reaching effect.

Advocates Truck Mixers

WHAT ROAD PAVING REALLY NEEDS: A Study of Concrete Road Paving and a Forecast of a More Efficient Production System—By Fred C. Wilcox. New York: The author, 626 Esplanade, Pelham Manor. Paper; 7½x10½ in.; pp. 35; tables.

BASED on the postulate that the 27E paving mixer has reached the limit of its usefulness in size, weight, capacity and refinements, the argument is made in this pamphlet that a change is necessary to a more flexible system of providing concrete for paving and that this is found in the truck mixer. In three sections or chapters the author analyzes present paving mixer performance and possibilities, indicates that truck mixers will assure a 20 per cent greater production at a 10 per cent increase in investment and finally summarizes the advantages and disadvantages of the two systems. The pamphlet is a worth-while contribution to the increasing number of discussions of truck mixers.

A Good Monograph

PUBLIC OWNERSHIP ON TRIAL: A Study of Municipal Light and Power in California—By Frederick L. Bird and Frances M. Ryan. Foreword by John Bauer, Ph.D., Director, American Public Utilities Bureau. New York: New Republic, Inc. Paper; 4¾x7 in.; pp. 186. 75c.

MR. BIRD and Miss Ryan have done a conscientious piece of work in gathering and digesting data on municipal ownership of electrical light and power plants in California. Their main conclusion is that the 25 municipal plants studied have more than justified their existence, although some of them fall short of a reasonable ideal in one or more respects. These failings do not

materially affect the financial soundness of the enterprises or prevent good service to consumers. The authors do not hesitate to point out what the failings are. They are at least equally positive and clear in stating what they believe to be the advantages resulting from municipal ownership. As might be expected in view of conditions in California and elsewhere today, most of the municipally owned plants consist of distribution systems only—that is, they buy current wholesale. There are notable exceptions, among both the smaller and the larger plants. The book is well written and should be pleasant and profitable reading to any one interested in municipal ownership of any class of utilities, regardless of which side he favors or whether he is neutral.

Publications Received

AMERICAN DOUGLAS FIR AND ITS USES—Prepared under direction of Axel H. Oxholm, Chief, Lumber Division. Bureau of Foreign and Domestic Commerce, Trade Promotion Series—No. 87. Paper; 6x9 in.; pp. 60; 36 illustrations. 20c. from Superintendent of Documents, Washington, D. C.

Tells about this widely used product from forest to ultimate consumer. Contains rather poor halftones and good reproductions of well-made pen-and-ink sketches. The first of a series on uses of American woods in foreign markets.

FACTS ABOUT FIRE INSURANCE: 1930 Edition—New York: Lockwood Greene Engineers, Inc., 101 East 42d St. Paper; 6x9 in.; pp. 20; line cuts and tables.

Revision of a concise summary of fire insurance essentials for the benefit of the insured.

HIGHWAYS HANDBOOK, 1929—Paper; 6x9 in.; pp. 97; illustrations and tables. Washington, D. C.: Highway Education Board, 1723 N St., N. W. 50c.

An exhibit of the progress and status of improved highway construction, chiefly in the United States but with world-wide summaries and notes. Mostly graphic and statistical.

HIGHWAY SIDEWALKS—Bulletin of American Society for Municipal Improvements. Paper; 8x11 in.; pp. 8. For copies address C. W. S. Sammelman, Secretary A.S.M.I., City Hall, St. Louis, Mo.

Embodies resolution of society named above in favor of provision of sidewalks for all public highways on which there is considerable automobile traffic; abstracts various writings in support of the plan; summarizes legislation (mostly notable for entire lack) in 36 of 48 states; gives draft of proposed statute authorizing state highway commissions to build and maintain sidewalks on at least one side of all state highways.

ILLINOIS RIVER STUDIES, 1925-1928—By C. S. Boruff and A. M. Buswell. Bulletin No. 28. Cloth; 6x9 in.; pp. 127; line cuts and tables. From Division of the State Water Survey, Urbana, Ill.

Houseboat studies of stream pollution. Many tables.

LUMBER: Simplified Practice Recommendation R16-29, U. S. Bureau of Standards. Fourth edition. Paper; 6x9 in.; pp. 94; many illustrations. 30c. from Superintendent of Documents, Washington, D. C.

SEWAGE AND SEWAGE DISPOSAL—By Arthur J. Martin, Chartered C.E., M.Inst.C.E., Inst. Water Eng., Cons. Engr., F.G.S., Council of the Royal Sanitary Engineers and of the Assn. of Mgrs. of Sewage Disposal Works. London: MacDonald & Evans, 8 John St., Bedford Row, W.C.1. Paper; 5¼x8¼ in.; pp. 62. 2s., 6d. net.

In the popular lectures here reprinted Mr. Martin, well known on both sides of the Atlantic as a past and present master of his subject, has well accomplished the purposes stated in his preface as "to set forth the underlying principles" of sewage disposal "in a clear and interesting manner."

THE PORT OF BOSTON, MASSACHUSETTS—Prepared by the Board of Engineers for Rivers and Harbors, War Department, and Bureau of Operations, United States Shipping Board. Revised, 1929. Paper; 6x9 in.; pp. 238; halftones, tables and folding maps and graphs. 45c. from Superintendent of Documents, Washington, D. C.

Revision of early report to correct obsolete statements and include later information. The series of which this is a part was started in 1921 and has now reached No. 22.

PRINCIPLES OF PROPERTY INSURANCE—By F. E. Wolfe, Ph.D. New York: Thomas Y. Crowell Co. Cloth; 6x8⅝ in.; pp. 393. $3.

A comprehensive review of various classes of property insurance; designed primarily as a college textbook but might be highly useful to any business or industrial manager concerned with fire, marine, automobile, surety, title, credit or other kinds of property insurance. Mostly devoted to fire insurance. Has 20 pp. on Fire Waste and Effective Prevention.

STATE WATER POLICY COMMISSION REPORT: Water Supply Problems of the Northern Metropolitan District, and Activities of the Commission July 1 to Dec. 31, 1929. Newark: State Water Policy Commission, 605 Broad St., Trenton; State House Annex; Paper; 6x9 in.; pp. 52; tables and fourteen folding plates.

Recommends that urban portions of New Jersey be set off in four water districts and outlines plan of development of supply for northern district. See *Engineering News-Record*, March 13, p. 458.

STEEL TREATING: Books of Interest to Members of the American Society for Steel Treating. Newark, N. J.: Public Library. Paper; 3x6 in.; pp. 16.

Classified list with author, publisher, date, price and library classification number. Includes periodicals as well as books.

A STUDY OF CIRCUMFERENTIAL BENDING of Pipes and Cylindrical Containers—By Raymond J. Roark, Associate Professor of Mechanics. Researches in Applied Mechanics—Edward R. Maurer, Professor of Mechanics. Engineering Experiment Station Series No. 69. Madison: University of Wisconsin. Paper; 6x9 in.; pp. 48; 34 halftones and line cuts. 75c.

The author states: "This bulletin presents the results of a partial analysis of the circumferential bending moments produced in horizontal thin cylinders filled or partially filled with liquid and supported in different ways, and of the bending moments produced in the rings used to stiffen or support such cylinders."

THE TREATMENT OF DAIRY WASTES—By E. W. Steel and P. J. A. Zeller. Bulletin 38, Texas Engineering Experiment Station. College Station, Tex.: Agricultural and Mechanical College of Texas. Paper; 6x9 in.; pp. 16; tables.

Concludes that: "Wherever possible a trickling filter rather than chemical methods should be used to treat dairy wastes."

Letters to the Editor

Tests of Large-Size Columns—A Correction

Sir—In looking over the article "Tests of Large-Size Columns of Three Grades of Structural Steel," in *Engineering News-Record*, Dec. 26, 1929, p. 999, I find that a slight error occurred in the values of the areas of the column sections, Table I. These errors resulted from changes made in the sizes of plates and angles used in the carbon-manganese steel test columns. Only the last four lines of the table are affected and these lines with their correct values are given herewith.

TABLE I—GEOMETRICAL PROPERTIES OF TEST COLUMNS

Test Col. No.	Fabricated of	Area, Sq.In.	Length, Ft.	Moment of Inertia, In.⁴ I_{x-x}	I_{y-y}	Radius of Gyration, In. $r_{(x-x)}$	$r_{(y-y)}$	l/r $x-x$	$y-y$
1	C-Mn steel	151	24'0"	14,995	14,995	9.97	9.97	28.9	28.9
2	C-Mn steel	151	24'0"	14,995	14,995	9.97	9.97	28.9	28.9
1	C-Mn steel	155	20'9"	31,043	17,259	14.14	10.54	17.6	23.6
2	C-Mn steel	155	20'9"	31,043	17,259	14.14	10.54	17.6	23.6

R. S. JOHNSTON,
Engineer of Research and Tests,
Port of New York Authority.

New York City,
Feb. 8, 1930.

Sewer and Sewage Defined by Pennsylvania Court

Sir—The following definitions of "sewer" and "sewage" may be of interest to your readers. The definitions were laid down by the Supreme Court of Pennsylvania, in the case of Wilkinsburg Borough vs. The School District, Appellant, 298 Pa., 193, citing numerous other cases as authorities:

In the common sense of the term [a sewer] means a large, and, generally, though not always, underground passage or conduit for fluid and feculent matter, from a house or houses to some other locality, and usually the place of discharge. Other courts have defined a sewer to be a closed or covered waterway for conveying and discharging filth, refuse and foul matter, liquid or solid, while ditches are drains which are, or may be, open and so arranged as to take away surface water. Formerly the word sewer was used to indicate a fresh-water trench, compassed on both sides with a bank . . . [but] the term sewer cannot be construed to mean the same as drainage. [The] secondary meaning [of the word sewage] is derived from the usual character of the contents of a sewer, and, as used in that sense, the word signifies the refuse and foul matter, solid or liquid, which is so carried off.

The case arose under the following facts: Under an act of legislature, the borough was permitted to assess school districts for benefits accruing from the building of a "sewer or sewer connection." In the instant case there was a resolution of council providing only "for a culvert to cover creek bed" and the report of viewers assessing benefits so describes it. It was therefore held by the Supreme Court that the school district cannot be taxed for this structure, as it was a culvert and not a sewer.

SAMUEL I. SACKS,
Of Sacks & Piwosky, Attorneys-at-Law,
M.Am.Soc.C.E.

Philadelphia, Pa.
Feb. 27, 1930.

News of the Week

Missouri Landowners Demand Removal of Wilby

Voicing indignation at what was termed "army gag rule," citizens of Mississippi and adjoining counties in Missouri at a mass meeting recently held in Charleston denounced the United States Engineers for their part in the assessment and approaching condemnation of land for the Birds Point-New Madrid floodway in that state, and requested the removal of Lieut.-Col. F. B. Wilby, district engineer at Memphis, "as one wholly unfit to further fairly represent the government in this proceeding."

The specific case referred to is an interview published in the Memphis *Commercial Appeal* of March 4, 1930, in which Colonel Wilby is quoted as saying that condemned lands have been appraised at from $218 to as high as $3,031 an acre, whereas it is contended that no lands have been valued at a greater price than $140 an acre, with a minimum of $35 an acre. The landowners contend that these are actual valuations and that the balance of damage awards should be allocated to land damages suffered on account of interference with drainage canals, tiling systems, homes, barns, fences, orchards and other property.

Queens Sewer Scandals Find Echo in Dismissal of Engineer

Clifford B. Moore, who was consulting engineer for the Borough of Queens, New York City, during the Queens sewer scandals, was on March 14 dismissed from the service of the borough. He had previously been reduced to his civil service rating of assistant engineer. Mr. Moore was found guilty of seven of ten charges of incompetence which had been filed against him, involving the approval of contracts for the construction of certain sewers at prices far above the engineers' estimate of probable cost.

Bids Asked on Yakima Extensions

Bids will be opened on April 16 in the Ellensburg (Wash.) office of the U. S. Bureau of Reclamation for the construction of approximately 6 additional miles of the High Line canal on the Kittitas division of the Yakima irrigation project in Washington. Specifications include construction of the Johnson Creek siphon and also the 3,470-ft. tunnel, 6.7 ft. in diameter, near Whipple Creek. The canal itself will be 18 ft. in width at the upper end. Specifications provide for excavation of approximately 118,000 cu.yd. of material and the placing of 3,400 cu.yd. of concrete, 84,000 lb. of reinforcing steel and 2,600 lin.ft. of precast concrete pipe from 18 to 72 in. in diameter. Johnson Creek siphon consists of two siphons joined together by a short tunnel. It will be of 72-in. concrete pipe, 1,500 ft. long.

Excess Condemnation Case Before U. S. Supreme Court

Several states which have amended their constitutions to provide for excess condemnation of land for public improvements will be affected by the outcome of a case now before the U. S. Supreme Court. The taking of property for the widening of a street in Cincinnati, Ohio, in excess of what was actually required for the new street width has been contested upon the ground that this is confiscation within the meaning of Article XIV of the U. S. Constitution. Should the amendment to the Ohio State Constitution be held to be in conflict with the Constitution of the United States, the validity of similar amendments in other states will be seriously in question. In recognition of this, the State of New York has obtained permission to intervene in the present case.

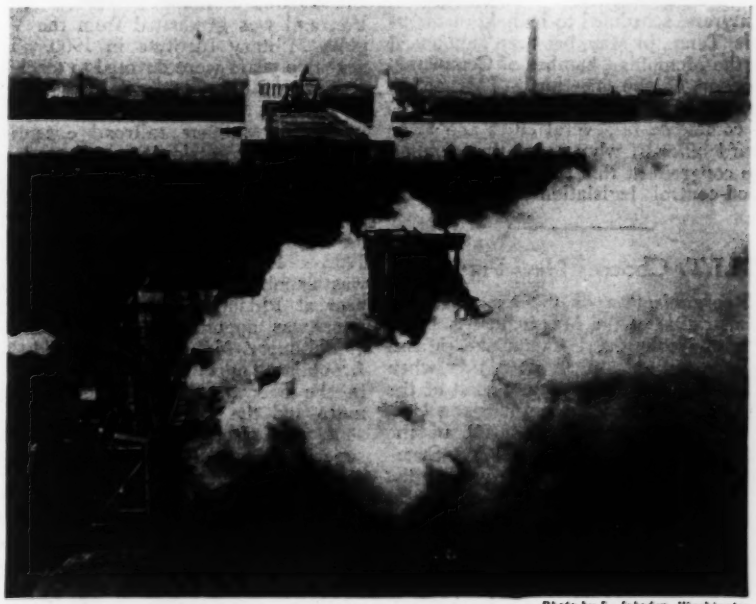
Construction Started on Second New England Power Project

Work has been started on the McIndoes dam, the second of the three projects involved in the $14,000,000 development of the New England Power Association on the upper Connecticut River in Vermont and New Hampshire. The McIndoes dam is downstream from the lower Fifteen Miles Falls development, now under construction. It will be 860 ft. long and will develop 9,000 kw., which will be transmitted to the lower Fifteen Miles Falls plant for distribution.

Herschel Will Provides for Hydraulic Laboratory

A bequest of $50,000 for an endowed laboratory of applied practical hydraulics to be established at Harvard University was provided for in the will of Clemens Herschel, eminent hydraulic engineer and past-president of the American Society of Civil Engineers, whose death was noted in our issue of March 6, p. 415. The $50,000 is set aside as a trust fund to go to Harvard upon the death of Mrs. Herschel, who

FORMWORK FIRE SLIGHTLY DAMAGES ARLINGTON MEMORIAL BRIDGE



—Photo by L. Johnson, Washington.

Fire on March 12 did damage estimated at less than $10,000 to one of the piers on the Virginia side of the Arlington memorial bridge over the Potomac River. Repouring will be necessary on about half of a concrete deck area 85x35 ft., and a few ashlar facing blocks must be reset. The origin of the fire is not known. The span affected is on the flats on the south shore of the river and has not yet been joined to the main portion of the structure. The N. P. Severn Co., Chicago, is the subcontractor.

has the use of the income from this fund during her lifetime. The will also bequeaths to the Boston Society of Civil Engineers and the Boston Public Library any of Mr. Herschel's books which they may desire, and provides funds of $1,000 each under the supervision of Harvard University and the Boston Society of Civil Engineers for the establishment of prizes for studies in engineering. These prizes are to consist of the volume "Frontinus and the Water Supply of the City of Rome" translated from the Latin by Mr. Herschel.

Explore Pine Canyon Dam Site

Prior to awarding contracts for the construction of the Pine Canyon dam in connection with a municipal water-supply project, the city of Pasadena, Calif., is undertaking certain exploratory work under the direction of S. B. Morris, chief engineer of the municipal water department. This work includes the construction of a main outlet tunnel, which is being driven prior to dam construction on account of its value for testing the westerly dam abutments. A shaft and a tunnel are being driven below streambed and a number of other test tunnels and shafts within the dam site in order adequately to explore foundation conditions before completion of the dam designs and their submission to the state engineer for approval.

Flood-Control Meeting Postponed

Indefinite postponement of the National Flood-Control and Navigation Congress, scheduled to be held in Memphis, Tenn., in May, has been announced by the Memphis Chamber of Commerce, sponsor of the meeting. This action was taken at the request of chambers of commerce in several cities and levee board officials, who stated that holding the congress at this time would hamper flood-control legislation now pending.

M.I.T. Chooses New President

Reorganization of the executive administration of the Massachusetts Institute of Technology, Cambridge, Mass., will be put into effect next July when Karl Taylor Compton, now head of the department of physics at Princeton University, will become president of the institute, succeeding Samuel W. Stratton, who will become chairman of the executive committee and of the corporation, a newly created executive position. Dr. Stratton will continue to share the responsibilities of administration, but will be relieved of much of the detail. He has been president of the institute for the last eight years.

Dr. Compton, born at Wooster, Ohio, in 1887, is a graduate of the College of Wooster and the holder of five honorary degrees from Wooster, Princeton and Lehigh. He has been vice-president and president of the American Physical Society, chairman of the division of physics of the National Academy of Sciences and consulting physicist for the U. S. Department of Agriculture. During the war he was aeronautical engineer for the U. S. Signal Corps.

George D. Brooke Heads Railway Engineering Association

George D. Brooke, general manager of the Chesapeake & Ohio Railway, was elected president of the American Railway Engineering Association at its recent annual meeting in Chicago. Mr.

GEORGE D. BROOKE

Brooke was born in 1878 at Sutherlin, Va., and was graduated from the Virginia Military Institute in 1900. The next two years were devoted to teaching at Culver Military Academy. In 1902 Mr. Brooke went into railroad work and, like many another railroad executive, began his professional career as rodman, levelman, transitman and assistant engineer in charge of field parties, occupying these positions successively on the Baltimore & Ohio Railroad from 1902 to 1908. In July of that year he was appointed assistant division engineer at Pittsburgh, Pa., and one year later was appointed division engineer at Baltimore, Md. In March, 1911, Mr. Brooke was appointed assistant engineer in the operating department at Baltimore and the following February was sent to Keyser, W. Va., as assistant superintendent. A few months later he was transferred to Winchester as superintendent of the Shenandoah division. Subsequently he served as superintendent of the Ohio and Cumberland divisions. In 1918 Mr. Brooke was appointed superintendent of the operating division of the United States Railway Administration at Philadelphia.

After the war Mr. Brooke returned to the Baltimore & Ohio as superintendent of transportation on western lines. In August, 1924, he left the B. & O. to become assistant to the vice-president in charge of operations, Chesapeake & Ohio Railway, at Richmond, Va., and in October, 1926, was appointed general manager of the system.

Mr. Brooke became a member of the American Railway Engineering Association in 1907 and has been active in its committee work almost continuously since that time. He also is a member of the American Society of Civil Engineers.

Park at Cumberland Falls Approved by Kentucky

Overriding a veto by Governor Sampson, the Kentucky Legislature on March 11 passed a bill accepting an offer made by former U. S. Senator P. Coleman du Pont, of Delaware, to provide funds for the acquisition for state park purposes of an area of approximately 2,200 acres at Cumberland Falls. Governor Sampson had vetoed the bill on the ground that it was local and special legislation and that it compelled the state to accept a gift of $230,000 which would obstruct an industrial development worth millions of dollars to the commonwealth. Application for development of a hydro-electric power project at this site is now before the Federal Power Commission.

American Firm Awarded Contract for Dam in Abyssinia

Arrangements have been finally completed for the construction and financing of a $20,000,000 dam across the Blue Nile near Lake Tsana, in Abyssinia, by J. G. White & Co., of New York City. Actual construction will be done by the J. G. White Engineering Corp., a subsidiary. The dam will be built to control the flow of the Blue Nile, the waters of which are intensively used for irrigation in Egypt. Bonds issued to defray the cost of construction will be amortized by water rents to be made by the Sudan government. Ownership of the dam, however, will rest in the Abyssinian government.

Contracts Awarded for a 48-Story Building (Correction)

The 48-story building for which rapid construction is planned, noted in *Engineering News-Record* of Feb. 27, p. 378, is not at Cleveland, as stated, but is the Carew Tower Building at Cincinnati, Ohio. It will include a 48-story office section, 28-story hotel, 26-story garage of the automatic elevator type, and a convention hall with seats for 3,000 persons, this hall being at the third floor level with a court above it. Work is already in progress. The architects are Walter W. Ahlschlager, of Chicago, with Delano & Aldrich as associates; Lieberman & Hein, Chicago, are the structural engineers, and Starrett Brothers, Inc., also of Chicago, has the general contract.

New York Plans Low-Cost Roads From Increased Gas Tax

Financing of farm-to-markets roads out of current revenue is provided for in a bill introduced into the New York Assembly by the terms of which the gasoline tax would be increased from 2c. to 3c. per gallon and 23 per cent of the total revenue so obtained applied to the construction of hard-surface roads 10 ft. wide leading to the main highway system of the state. It is estimated that the passage of this bill would make possible the construction of 1,500 miles of such roads annually, with an ultimate total of 25,000 miles contemplated. By the terms of the bill each county must raise one-fourth of the cost of the road, the state contributing three times the amount raised by the county, but not exceeding $6,000 per mile of road built.

The bill also provides for redistribution of the proceeds of the gasoline tax as follows:

	Per Cent
For state and county highways....	50
For farm-to-market roads	23
To the city of New York.....	11
Connecting roads in cities and villages	2
Secondary road system.....	14

Engineering Firm Expands

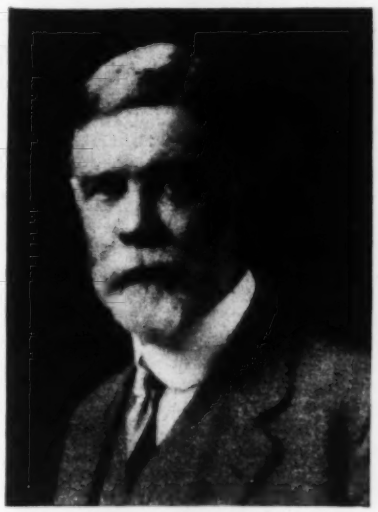
A new division for the design and construction of banks, office buildings and other commercial structures has been created by the H. K. Ferguson Co., Cleveland, Ohio. It will be headed by Walter J. Aring, who for six years has been in charge of development and maintenance of all property owned and controlled by the Union Trust Co., of Cleveland. The Ferguson company has also acquired the DeVore Co., Toledo, Ohio, for many years a specialist in glass plant and paper mill layout and design. H. C. Van Tine, president of the DeVore Co., will join the Ferguson company as contract engineer and consultant in the design of glass and paper factories.

Committee Appointed to Develop Plastering Specifications

A sectional committee on specifications for plastering was organized Feb. 24 under the joint sponsorship of the American Institute of Architects and the American Society for Testing Materials for the purpose of developing specifications for lime, gypsum and cement plastering under the rules of procedure of the American Standards Association. Personnel of the committee includes representatives of the producers of plastic materials, of materials to which plaster are applied, of consumer interests and of those responsible for the execution of the work. Officers were elected as follows: chairman, A. O. Lynas, Dwight P. Robinson & Co., Inc., New York City; vice-chairman, Leroy E. Kern, American Institute of Architects, Washington, D. C.; secretary, Frank B. Stevens, Jr., Stevens Master Specifications, Inc., Chicago, Ill. Four working committees were appointed to consider lime plastering, gypsum plastering, cement plastering and metal lath. In addition, there is to be a co-ordinating committee which will receive the reports of the other committees and incorporate these into complete specifications for plastering.

Grant Heads Canadian Engineers

Election of Alex. J. Grant to the presidency of the Engineering Institute of Canada, announced in *Engineering News-Record* Feb. 20, 1930, p. 339, brought additional honor to the engineer in charge of construction of the Welland Ship Canal. Mr. Grant was born in



ALEX. J. GRANT

Scotland in 1863 and went to Canada in 1872, where he was educated at the University of Ottawa and St. Mary's College, Montreal. His professional career began in 1880 on a survey party west of Winnipeg for the Canadian Pacific Railway. In July, 1886, he entered the outside service of the Department of Railways and Canals by joining the engineering staff of the Cape Breton Railway, where he was assistant engineer on construction. In 1891 he was transferred to the engineering staff of the Soulanges Canal, serving as assistant engineer until 1903, when he was placed in charge of the Port Colborne improvements. Promotion to the position of superintending engineer of the Trent Canal came in 1906. Under Mr. Grant's charge, the construction of the Ontario-Rice Lake division of the waterway was carried out, and surveys and plans were made for the Severn River division. Construction works for improving the navigation of the Severn River were begun under his supervision, but were suspended due to war conditions. Early in 1919, Mr. Grant was transferred to his present position of engineer in charge of construction of the Welland Ship Canal, which project is now very near complete. Mr. Grant joined the Engineering Institute of Canada in 1891 and has served as branch chairman and vice-president.

Stewart Mountain Power Plant Placed in Service

After making a test run for several days, engineers of the Salt River Valley Water Users' Association of Arizona on March 11 turned water through the power plant at the recently completed Stewart Mountain dam at an initial rate of 376 sec.-ft., with an electric power production of 600 kw. At that time the 45-kv. transmission line connecting this plant with the rest of the association's system was cut into service. An hour later the rate of flow was increased to 537 sec.-ft., which resulted in increasing the electrical production to 1,500 kw. The plant was running at the same output March 12, regulating the amount of power produced by the quantity of water ordered for irrigation in the valley. Engineers are being careful not to fill the reservoir too rapidly in order to let the concrete set in the dam. The $2,300,000 dam has now become an integral part of the Salt River Valley project.

Engineering Council Appoints Committee on Airports

Appointment of an airport committee to work with the bureau of aeronautics of the U. S. Department of Commerce in developing a report indicating the diversity and importance of engineering problems in the design of airports has been announced by the American Engineering Council. Members of the committee are as follows: Prof. Ralph J. Fogg, department of civil engineering, Lehigh University, chairman; Perry A. Fellows, city engineer, Detroit; W. W. Horner, chief engineer, St. Louis; Harrison E. Howe, editor, *Industrial and Engineering Chemistry;* Alexander Klemin, Guggenheim school of aeronautics, New York University; and H. G. Shirley, commissioner of highways, Richmond. The bureau of aeronautics has also asked the American Engineering Council to join with it in making a study relating to the coverage and drainage used for airports.

Lamont Traffic Relief Committee Meets in Washington

Causes, remedies and methods of procedure in handling and solving the automobile traffic and highway congestion problem of the country came in for thorough and detailed consideration March 4 in Washington, D. C., at the hands of the committee on measures for the relief of traffic congestion of the National Conference on Street and Highway Safety.

The committee, of which E. J. Mehren, of Chicago, vice-president, McGraw-Hill Publishing Co., is chairman, is preparing recommendations in the matter to the Third National Conference on Street and Highway Safety, which has been called by Robert P. Lamont, Secretary of Commerce.

That united action by public authori-

ties and civic and business organizations in different localities, in co-operation with state and national authorities, provides the logical approach to a solution of the question and the means for carrying out a remedial program on a nation-wide basis is the general conclusion of the committee.

Some of the factors and considerations tentatively recommended are as follows: Further restrictions of the uses to which many streets may be put are necessary, with obvious rearrangements, readjustments and the opening of additional arteries. Changes in the routing of street cars, especially to abolish left turns, are favored, as is the movement of commercial trucks at off-peak periods of congestion. Greatly increased off-street loading facilities and restricted parking of taxicabs as well as private cars are essential.

Since there is a dearth of scientific information available with causes and effects accurately defined, a national agency for the scientific study with a research corps to be established by the U. S. Chamber of Commerce is tentatively recommended.

Start Work on Hansen Dam

Appropriate ceremonies held on Feb. 25 marked the official opening of the Los Angeles County flood-control program in the Big Tujunga Canyon, when the first shovelful of earth was turned in the work of constructing the Hansen dam. This dam, one of a number planned for the control of flood-waters, will be about 200 ft. high above streambed and will cost approximately $1,000,000. E. C. Eaton is chief engineer of the Los Angeles County Flood-Control District.

Personnel Changes in Georgia Highway Administration

J. W. Barnett, of Athens, Ga., has been appointed both member and chairman of the Georgia State Highway Commission to succeed Sam Tate, who has resigned, effective April 1. Mr. Barnett, a graduate of the University of Georgia with the degree of civil engineer, has been city engineer of Athens since 1890 and for many years has also held position as superintendent of the water-works for that city. He is a member of the American Society of Civil Engineers.

Changes in personnel of various highway engineering and maintenance offices of the Georgia highway department coincident with a complete reorganization have been announced. Division engineers and assignments are: Division 1, Cartersville, W. F. Montgomery, former senior resident engineer at Rome; division 2, Gainesville, E. A. Fish, former senior resident engineer at Griffin; division 3, Thomaston, W. S. Dennis, formerly in charge of the Dublin division; division 4, Louisville, H. E. Newton, former division engineer at Waycross; division 5, Moultrie, C. H. Wheatley, a resident of Americus, who has been county engineer of Sumter County; division 6, Waycross, H. J. Friedman, former district engineer at Savannah. Under the new arrangement, Savannah and Americus are eliminated as division offices.

B. P. McWhorter is Georgia's state highway engineer, succeeding Warren R. Neel, whose resignation was noted in *Engineering News-Record* Feb. 16, 1930, p. 303.

The Business Outlook

The latest week's indicators show increasing irregularity in the business trend. Basic industrial activity tends to slacken further, except building, and commodity price weakness continues. Steel mill operation has declined for the third consecutive week, and at a somewhat sharper rate. The average rate of steel-ingot production for the industry is around 76 per cent, as compared with about 79 a week ago and 94 last year. Coal production has been declining steadily since the beginning of the year and is now lowest since the spring of 1928. Petroleum production also is lowest since December, 1928, and the daily rate is more than 400,000 bbl. below the peak of September, 1929.

—The Business Week, March 19.

Brief News

Massachusetts has named two mountains in the state forests area after Simon Borden and Henry F. Walling, engineers who took a leading part in the state triangulation survey made about 1830.

Rails Weighing 130 lb. to the yard now extended the entire length of the double-track main line of the Pennsylvania Railroad between New York and Chicago. The heavy section has been in use since 1916 for replacement purposes.

Texarkana has completed a municipal building containing an auditorium, municipal and general offices, and a wing devoted to fire department purposes. The cost of $300,000 was financed by a special bond issue.

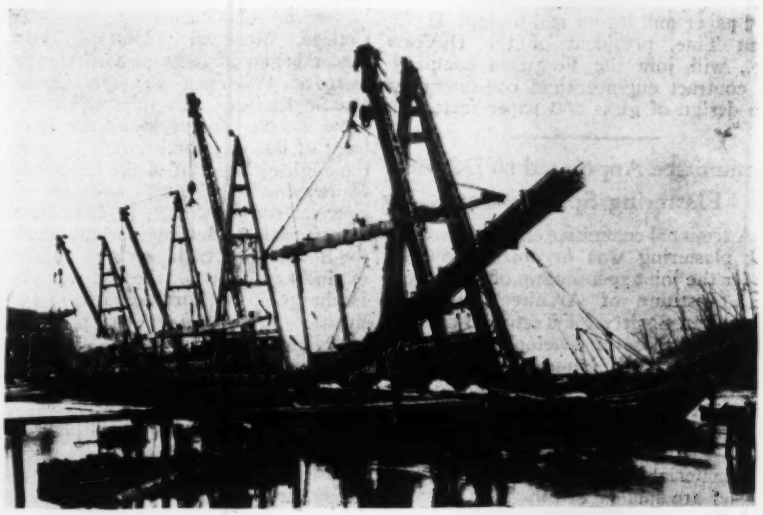
Charlotte, N. C., has contracted for the preparation of a city plan and zoning ordinance by Herbert S. Swan, consulting engineer, of New York City.

The Tallest Structure in Memphis, Tenn., a 29-story office building, has just been completed.

Survey of the Cheakamus River to determine possibilities for a municipal hydro-electric plant has been authorized by the city council of Vancouver, B. C., which has appropriated the sum of $25,000 for this purpose.

Two 110-Kv. Transmission Lines are projected in the Far West. Work has started on a new 48-mile double-circuit line to cost approximately $720,000 from the Ashlan substation of

LAYING BANK OF 660-FT. CONDUITS WITH FLOATING DERRICKS



Four heavy floating derricks lashed together in tandem formation laid this bank of 36 4-in. electric conduit pipes across the Harlem River at Spuyten Duyvil, New York City, in one operation. The pipes, 660 ft. long, were assembled on a temporary dock and picked up by the four derricks acting in unison. Hangers of varying length gave the pipes the proper curvature to fit the contour of a trench on the river bottom, the pipes bending as they were lifted. Power cables for the West Side electrification development of the New York Central Railroad will be carried through the conduits, which were laid by the Merritt-Chapman & Scott Corporation, of New York City.

the San Joaquin Light & Power Corporation near Fresno, Calif., to its Wilson substation near Merced. Only one circuit will be built at present. Contracts have been awarded for material for a new 64-mile line to be built by the Washington Water Power Co. from Spokane, Wash., to Kellogg, Idaho, to serve the Coeur d'Alene mining district.

ELIMINATION of seventeen existing grade crossings at Dunkirk, N. Y., has been ordered by the Public Service Commission at an estimated cost of $3,500,000. This is the third largest single project ordered by the commission, being exceeded only by elimination work at Syracuse and Elmira.

A WIND TUNNEL for the testing of airplanes will be built at Langley Field, Va., by the J. A. Jones Construction Co., of Charlotte, N. C. The building will be 640x220 ft. in dimensions and 100 ft. high. It was designed by B. O. Hood, of the Southern Engineering Co., Charlotte.

HEARINGS on the water controversy between the states of New Jersey and New York will be started April 21 before Charles N. Burch, special master for the U. S. Supreme Court, at Trenton, N. J.

LOUISIANA HIGHWAY BONDS to the amount of $6,000,000 were sold March 1 on an interest basis equivalent to 4.725 per cent.

EXPORT OF ELECTRICITY from Norway to Germany is under consideration by means of a proposed 300,000-volt transmission line which would cost approximately $20,000,000. Preliminary negotiations for this project are now under way between the two governments concerned.

AUTHORIZATION of a $1,500,000 railroad tunnel nearly a mile long under the western part of the city of Quebec has been requested of the Canadian Parliament by the Canadian Pacific Railway. The tunnel, which would afford a direct connection to the harbor front, would start near the St. Malo workshops and run through to Wolfe Cove.

THE UNIVERSITY OF ILLINOIS will dedicate its new materials-testing laboratory, celebrate the completion of 25 years of research by the engineering experiment station, and hold a conference on teaching and research in engineering materials on May 2 and 3.

A $2,000,000 DOCK IMPROVEMENT PROGRAM is planned by the New Orleans Dock Board during 1930, to include the rebuilding of the docks from Canal St. to Esplanade Ave., and the erection of a specially designed dock for use of the Morgan Steamship Line. Plans for the project have already been prepared and are now being studied by officials. The levees from the foot of Canal St. to Esplanade will be widened and strengthened. Railroad tracks will be rearranged to conform to the new dock plans.

WASHINGTON NOTES

By PAUL WOOTON
Washington Correspondent

Increase in Federal Aid Still Delayed — O'Fallon Case Back In Court—Wages on Public Work

DISCUSSION of the differences between the federal-aid bills passed by the House and that approved by the Senate are in progress at this writing. There is no indication as yet that the deadlock has been broken, but some compromise is a daily possibility. Such pressure has been brought on the conferees by the administration, by state highway officials and by others interested in road construction that it seems unlikely that the impasse can continue much longer. As it is, the conferees are being charged with having contributed materially to unemployment.

The action of Samuel Eckels, chief engineer of the State Highway Department of Pennsylvania, in having called a meeting of the representatives of the material, construction and equipment interests to urge the early placing of orders for aggregates and equipment is being commended in Washington as a very effective step in support of the President's public works program. By placing orders for roadbuilding materials and roadbuilding machinery in advance requirements could be taken care of in an orderly way.

Pan-American Highway

In order to carry out the terms of the Pan-American highway act, the United States Senate on March 12 approved an appropriation of $50,000 to cover the expenses of a reconnaissance survey of the section of the route between the Republic of Panama and Texas. This appropriation is included in the deficiency bill which already has passed the House. In passing the bill, the House left out the sum, however, acting on the premise that it would be better to wait until a larger number of the governments involved have indicated that they are interested in the project.

The Senate appropriations committee decided to insert the item in the bill after the matter was explained by Wilbur J. Carr, Assistant Secretary of State. The bill will now go to a conference committee of members of the two houses of Congress for the purpose of working out an agreement on the items added by the Senate. It is believed that the House conferees will readily adopt the $50,000 for the inter-American highway survey.

California Rail Plans

The Interstate Commerce Commission soon will have to rule on the project of the Great Northern and Western Pacific to build a 200-mile link between Klamath Falls, Ore., and Keddie, Calif. No railroad construction project in recent years has aroused greater interest than this plan, originally proposed by James J. Hill, to create a through north and south route on the Pacific Coast affording service over 38,000 miles of line. Final argument April 16 will place the fate of this project in the hands of the commission for decision.

Railway Valuation

The St. Louis & O'Fallon Railway soon will be back in court again. In conformity with the Supreme Court's decision last May the Interstate Commerce Commission has reopened this long-contested case for hearing on May 5 to determine its valuation in successive years for the purpose of recapturing one-half of all income in excess of 6 per cent.

Although the road won recognition for current cost of reproduction in its first round with the commission, the court scrupulously refrained from disclosing how much weight should be given to this element of value. As the commission, in the meantime, has suggested that Congress should write into the statute a method that for all practical purposes is the same as that applied to the O'Fallon, it seems likely that the commission has not been persuaded to give controlling weight to replacement value.

Working Conditions

Two House bills fixing the type of labor, hours and wages for contractors and subcontractors on public works were subject to an open hearing on March 6 before the House committee on labor. Representative Bacon's bill provides a maximum eight-hour day and establishes a preference list favoring ex-service men, citizens in the locality of the job, other citizens, and aliens in the order named. Representative Sproul's bill says that a laborer on the construction or repair of government work shall be paid at a rate not less than the prevailing wage scale in the locality for a like class of work. Both bills apply a penalty of $5 per man-day for violations, outline procedure for complying, and provide inspection. According to the present wording, these rules would not apply when the government does the work on a day labor basis.

Labor delegates and several Representatives appeared in favor of the proposed legislation. O. W. Rosenthal, president of the Builders Association of Chicago, and C. J. Norman, chairman of the board of governors for the Building Association of New York, stated that they would co-operate in shaping clear-cut wage laws but that they were unwilling to have the contractors' hands tied in judging the ability of a prospective employee and hiring on that basis.

Sentiment among contractors is divided as to the bills. Local firms meeting the competition of outside contractors bringing cheap labor to the job generally favor some action along the lines suggested. Some large firms doubtless would oppose on the reverse grounds.

Personal Notes

CLIFFORD W. HAM, president of the International Association of City Managers, has resigned as city manager of Pontiac, Mich., and has been succeeded by JAMES R. POLLACK, city engineer, as acting city manager.

JOSIAH H. FITCH, who formerly was city manager of Fort Myers, Fla., has been elected mayor of that city. Mr. Fitch some years ago was chief engineer of the Borough of the Bronx, New York City.

WILLIAM WILLOUGHBY has been appointed designing engineer in the Baltimore (Md.) municipal bureau of highways as successor to Samuel M. Johnson, resigned.

A. M. JENSEN, for the past five years city commissioner of public works, Fresno, Calif., has resigned to re-enter private practice as civil engineer, with offices in San Francisco.

JAMES D. MARSHALL, who has been employed by Harrington, Howard & Ash and Ash, Howard, Needles & Tammen as squad boss for the past two years, is entering in business independently in Kansas City, Mo., doing structural designing as well as furnishing structural details to steel fabricators.

H. G. THIELSCHER, of McClellan & Junkersfeld, Inc., New York, is acting as consulting engineer for the San Joaquin Light & Power Corporation, Fresno, Calif., in connection with the design of its 35,000-kw. steam plant now under construction.

GORDON E. FERGUSON, right-of-way engineer for the Westchester County Park Commission, has received a six months' leave of absence to make a survey of property values in the town of Rye, N. Y., to enable the town board to bring the assessed valuations up to actual sale values.

A. GIDEON has been appointed consulting engineer to the Metropolitan Water District of Manila for two years, with residence in the United States. Mr. Gideon has been in service in Manila for more than 26 years, as chief engineer of water supply and sewers, city engineer and for the last ten years manager and chief engineer of the water district. He will make his headquarters in Oakland, Calif.

CYRIL AINSWORTH, formerly director of the bureau of industrial standards of the Pennsylvania Department of Labor and Industry, has been appointed to direct the national safety code work of the American Standards Association. Mr. Ainsworth, who was also formerly with the contruction department of the Pennsylvania Railroad and the United Gas Improvement Co., of Philadelphia, will direct the work of the association in the establishment of national codes for the guidance of state and municipal governments, industrial organizations and insurance companies.

Obituary

CARL PLEASANT, a civil engineer who had done engineering and contracting work in Kansas City, Mo.; Tulsa, Okla., and Phoenix, Ariz., died on March 14 in Phoenix, aged 43. He was a graduate of the University of Kansas. His chief work was the Carl Pleasant dam, near Phoenix, a 259-ft. structure financed and built by him.

WILLIAM ABBOT PRATT, of Waynesboro, Va., died on March 16. He was 80 years old. Mr. Pratt was employed in the construction of the Baltimore & Ohio Railroad system and laid the first railroad line in Alaska. His engineering work also carried him through Mexico and Canada. From 1898 to 1902 he was professor of engineering at Delaware State College.

HARRY TANDY, internationally known railway construction engineer, died at Kingston, Ont., on March 10 at the age of 85. He was born at Stepney, England, and went to Canada when young, entering the service of the Grand Trunk Railway. In 1880 Mr. Tandy took charge of the construction department of the Canadian Pacific, engaged in extending that line to Selkirk. Afterward he spent some years in the United States, and returning to Kingston in 1898 he became superintendent of the Canadian Locomotive Co. Mr. Tandy was an honorary member of the American Railway Association.

FRANCIS DEWOLF THEOBOLD, 51 years of age, a prominent engineer of Baltimore, died on March 13 at the Union Memorial Hospital, Baltimore, after a brief illness.

JOHN ANSON MCINTYRE, formerly city engineer of Denver, Col., and more lately engaged in contracting business, died in that city March 9 at the age of 79. He had been a resident of the West since 1881. Mr. McIntyre, as a contractor, built the U. S. Mint, the public library, the Immaculate Conception cathedral and many other large edifices in Denver. Among his major construction activities were the Pillsbury flour mills in the East, and the Mullen flour mills in Colorado.

OSCAR A. VEAZEY, one of the most widely known civil and mining engineers in southern West Virginia, died at his home at Pratt, W. Va., on March 13 at the age of 79. Mr. Veazey saw service as resident engineer on the Chesapeake & Ohio Railway main line about 1878 and located and built many branch lines in West Virginia. About 1893 Mr. Veazey laid out the city of Marlinton, W. Va. From 1899 until the time of his death he was mining engineer in a consulting capacity for Charles Pratt & Co., New York City.

SAMUEL M. FELTON, chairman of the Chicago Great Western Railroad and a director of the American Railway Association, died in Chicago on March 11. Mr. Felton, noted as an engineer and railroad executive, was born in Philadelphia in February, 1853, and was graduated from the Massachusetts Institute of Technology in 1873. He began work as a rodman on the Chester Creek Railroad in 1870, and was chief engineer of the Chester & Delaware River Railroad in 1873, general manager of the New York, Pennsylvania & Ohio Railroad in 1884, and vice-president of the Erie Railroad from 1885 to 1890. He was then with several Southern roads and was president of the Chicago & Alton Railroad for a few years, finally becoming president of the Chicago Great Western Railroad in 1909. He was prominent in general railway affairs, and at various times was president of the Western Railroad Association, Chicago Presidents Conference and similar organizations. During the World War he was adviser to the Chief of Engineers, U. S. Army, and director of military railways, being awarded the Distinguished Service Medal and the French cross of the Legion of Honor. He was a member of the American Society of Civil Engineers, the American Railway Engineering Association and the Western Society of Engineers.

Society Calendar

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; annual meeting, Atlantic City, N. J., June 23-27.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; spring meeting, Sacramento, Calif., April 23-24.

AMERICAN WATER WORKS ASSOCIATION, New York; annual meeting, St. Louis, Mo., June 2-6.

AMERICAN WELDING SOCIETY, New York; annual meeting, New York City, April 23-25.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; annual meeting, Augusta, Ga., March 31-April 2.

INTERNATIONAL CONGRESS OF BUILDING AND PUBLIC WORKS, London; fifth congress, London, England, May 26-30.

INTERNATIONAL RAILWAY CONGRESS, Madrid, Spain, May 5-15. American vice-president, T. S. Morgan, 119 West 42d St., New York.

WORLD POWER CONFERENCE, second plenary meeting, Berlin, Germany, June 16-25. American secretary, O. C. Merrill, Washington, D. C.

AMERICAN INSTITUTE OF QUANTITY SURVEYORS will hold its fifth annual meeting April 14-16 at St. Louis. F. E. Dishner, Detroit, is secretary.

AMERICAN SOCIETY OF CIVIL ENGINEERS has changed the date of its fall meeting, to be held in St. Louis, Mo., to Oct. 1-3 to avoid a conflict with the International Road Congress at Washington.

CANADIAN SECTION, American Water Works Association, held its tenth annual convention March 12-14 at Hamilton, Ont., with an attendance of about 200. Papers presented included descriptions of the water-works systems of Hamilton and Ottawa by W. L. McFaul and William Gore and a general discussion of pumping station equipment by W. C. Smith, city engineer of Oshawa, Ont. An exhibit of water-works equipment was held in connection with the convention at which 47 manufacturers were represented.

FLORIDA SECTION, American Water Works Association, the Florida State Board of Health and the University of Florida are sponsoring a four-day short course in water purification and sewage treatment to be held April 8-11 at Gainesville.

NEW JERSEY SEWAGE WORKS ASSOCIATION will hold its annual meeting, March 21-22 at Trenton. J. R. Downes, Bound Brook, is secretary.

Construction Equipment and Materials

Heavy Clay Products Institute to Hold Organization Meeting

Organized on a temporary basis at the last meeting of the American Society for Testing Materials at Atlantic City, the Heavy Clay Products Institute of America will meet in Washington April 2 to adopt a constitution and by-laws and select permanent officers. At the same time technical papers will be presented on the use of brick, tile, terra cotta, sewer pipe, drain tile and paving brick. It is the plan and purpose of the institute to serve and promote the use of these products in the construction field in the same manner in which the American Concrete Institute serves concrete products in the same field. L. B. Lent, Cleveland, Ohio, is now acting as secretary-treasurer.

Concrete Pavement Yardage

There is given below a tabulation of concrete pavement yardage awarded during the month of February, 1930, and also the total number of square yards awarded for roads, streets and alleys in the United States for the year 1930 to date as of March 1:

	Sq.Yd. Awarded During February, 1930	Sq.Yd. Awarded From Jan. 1, 1930 to March 1, 1930
Roads.....	5,356,904	10,601,167
Streets.....	1,453,716	2,760,513
Alleys.....	76,185	119,702
Totals....	6,886,805	13,481,382

Mechanical Track Tools Featured at Railway Show

The increasing extent to which labor-saving equipment is used in railroad track maintenance was very evident at the 22d annual show of the National Railway Appliance Association, held in the Coliseum at Chicago, March 10-13, in connection with the annual meeting of the American Railway Engineering Association. Even the field of the old-time extra-gang foreman, the "eagle eye" with his remarkable skill in surfacing and lining track, has been invaded by an instrument put out by Buff & Buff which is designed to do both operations. It is a small transit telescope so mounted that it can be set up on the rail with its line of sight over the gage side of the rail. Targets, similarly mounted, are provided for use in raising track and for sighting if necessary.

Few entirely new departures in equipment were shown, but there were many improved forms of older types. This was especially true of pneumatic and electric tools. The Ingersoll-Rand Co., for instance, has added trolley wheels to its pneumatic spike puller so that it can be pushed along the rail, rather than be lifted from tie to tie. Similar refinements in such tools and in power equipment for their operation were shown by Chicago Pneumatic Tool Co., the Electric Tamper & Equipment Co., the Maintenance Equipment Co. and the Syntron Co.

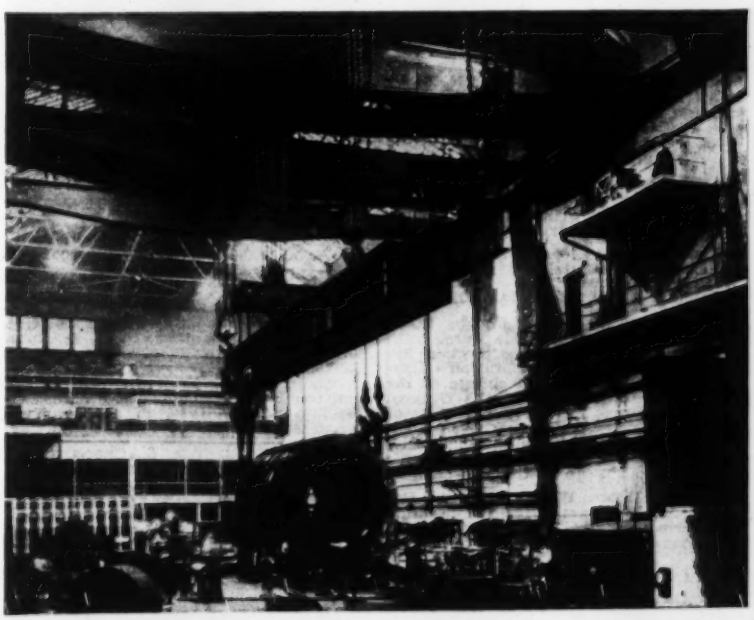
The Business Outlook According to the Southern Pine Association

Motorized maintenance equipment was present in greater variety than ever before, ranging from small signal maintainer's cars to a powerful motor-car type of inspection car for the International Railways of Central America, and from small cars mounting tie-adzing equipment to large tie-tamping and ballast-trimming cars and spray cars for weed killing. Displays of pneumatic equipment for spray painting also were numerous, showing the rapidity with which the application of paint by spraying is being adopted by railway companies. Flange lubricators, a relatively new development as a piece of track equipment, were more in evidence than in previous years; the American Valve & Meter Co., the Hopkins Co. and the Maintenance Equipment Co. all showed new devices of this kind in addition to those previously displayed.

Increased interest in highway crossing problems, in both track maintenance and signal protection, was indicated by the continuing number of devices on display for providing a safe and more permanent highway pavement across the tracks and for the protection of the public at crossings. Further interest in increased permanence was shown by the displays of precast concrete fence and sign posts, concrete cribbing for retaining wall by the Pendergast Co. and a small utility house of precast units displayed by the Massey Concrete Products Corp.

The Keystone steel tie, which has been used largely in narrow-gage work but never in a commercial way for standard-gage work, was displayed as a commercial product for the first time in the standard-gage field by the Bethlehem Steel Co. The same company displayed an interesting device for taking the contour of rail heads in the track. Displays of angle bars, fastenings and rail anchors all followed the general tendency toward more substantial and simpler construction and improvement in the quality or chemical composition of the metal. The same was true of

WELDED GIRDER LIFTS HEAVY LOADS



Four 50-ton shop cranes can combine to lift heavy loads by means of this heavy double-tree of arc-welded construction used in the East Pittsburgh, Pa., shop of the Westinghouse Electric & Manufacturing Co.

culvert pipe metal and the metal parts of track shovels.

Officers of the American Railway Appliance Association for the coming year are: president, W. H. Fenley, of the Kerite Wire & Cable Co.; vice-president, A. S. Anderson, Adams & Westlake Co., and secretary, C. W. Kelly, re-elected. New directors are L. E. Wolcott, H. W. Renick and F. E. McAllister.

Wood-Preservers' Association Moves

The headquarters of the American Wood-Preservers' Association have been moved from Chicago to Washington, D. C., with offices at 1104 Chandler Building, in charge of Horace L. Dawson, secretary. The service bureau maintained by this association and the National Lumber Manufacturers Association is continued at Chicago, with office at 111 West Washington St., in charge of P. R. Hicks, manager.

Business Notes

NATIONAL COMMITTEE ON WOOD UTILIZATION of the U. S. Department of Commerce will hold its annual meeting May 2 in Washington, D. C.

THE STRUCTURAL CLAY TILE INDUSTRY has been authorized by the Federal Trade Commission to call a trade practice conference, which will be held at St. Louis, Mo., March 31.

CUTLER-HAMMER, INC., Milwaukee, Wis., has placed M. C. Steffen in charge of its Cincinnati (Ohio) office. He succeeds R. I. Maujer, resigned.

BRODERICK & BASCOM ROPE CO., St. Louis, Mo., is now using its new office and warehouse building constructed adjacent to the St. Louis factory.

AMERICAN ROLLING MILL CO., Middletown, Ohio, is sending a delegation of five operating men to England to supervise operations in the specialty steel division of the John Summers & Sons Co., Ltd., Shotton works, of Shotton, Chester. Preparatory work in this new Armco unit will be supervised by M. E. Danford, assistant vice-president. William Hoover will be plant manager.

GREAT LAKES STEEL CORP., Detroit, Mich., a unit of the National Steel Corp., has contracted for two thermos mixer cars which will be used to carry hot pig iron from the Hanna Furnace Co. plant at Detroit to the Great Lakes plant at Ecorse, a distance of 3 miles.

MORRISON RAILWAY SUPPLY CORP., Buffalo, N. Y., has purchased the rails in track formerly operated by the Jamestown and Warren Street Railway Co., running from Jamestown, N. Y., to North Warren, Pa., a distance of approximately 25 miles of 70-lb. ASCE section rail. The company will start dismantling of tracks immediately.

R. G. HARRIS, formerly Pacific Coast manager of the General Cable Corp., with headquarters in San Francisco, has been appointed manager of the corporation's Denver office. Mr. Harris is in charge of the activities of all divisions of the General Cable Corp. in that territory. The title of Pacific Coast manager having been abolished, C. G. Gauntlett, Pacific Coast sales manager, has taken over Mr. Harris's duties, with no change in title.

AMERICAN HARD WALL PLASTER CO., Utica, N. Y., has started the manufacture of large concrete pipe for sewer purposes. The first products of the firm are to be used in Utica.

AMERICAN WOOD PIPE CO., Tacoma, Wash., whose plant has been closed for two years under receivership, will be reopened immediately by John Buffelin, who bought the plant at receiver's sale, and will be operated under the name of the Buffelin Wood Pipe Co. The steam power unit will be dismantled and electric motors installed. The plant represents an investment of $300,000 and has five dry kilns and a creosoting plant. Beyond the pipe products, the plant is equipped to manufacture wooden tanks and conduits for underground installations, and also for remanufacture of lumber into finish and various kinds of special building materials.

SIVYER STEEL CASTING CO., Milwaukee, Wis., has elected the following officers: chairman of the board, C. R. Messinger; president, L. S. Peregoy; vice-president in charge of sales, M. A. Fladoes; secretary, George L. Pollock; treasurer, C. A. MacDonald.

CONTINENTAL MOTORS CORP., Detroit, Mich., has elected W. R. Angell president, succeeding R. W. Judson, who becomes chairman of the board. Roger Sherman and James H. Ferry have been elected vice-presidents and B. F. Tobin, Jr., treasurer. The latter succeeds R. M. Sloane, resigned.

JAMES LEFFEL & CO., Springfield, Ohio, have removed their Minneapolis office to Chicago, effective March 1.

DAVID WHITE CO., INC., Milwaukee, Wis., has acquired the Wissler Instrument Co., of St. Louis, Mo., manufacturer of engineering instruments for the past 60 years.

WOLFF & MUNIER, INC., has been appointed licensee in the United States for the patented system of panel heating of Richard Crittall & Co., Ltd., London, England. This system provides radiant warmth from ceilings or walls without any apparent or visible means of heating.

AMERICAN ASPHALT PAINT CO., Chicago, Ill., has opened branch offices in New York City and Houston, Tex. The company's new plant at Kankakee, Ill., is now in production.

UNIVERSAL ATLAS CEMENT CO., Chicago, Ill., announces the following appointments in its sales department: O. H. D. Rohwer, assistant general sales manager, with headquarters at Chicago; N. A. Kelly, sales manager at New York City; A. O. Stark, assistant sales manager at New York City; William A. McIntyre, in charge of sales forces working out of Philadelphia.

NATIONAL LUMBER & CREOSOTING CO., Texarkana, Ark.-Tex., has elected Albert E. Ferguson vice-president and a director of the company. Mr. Ferguson was formerly general sales manager.

GALION IRON WORKS & MANUFACTURING CO., Galion, Ohio, has elected the following officers: chairman of the board, D. C. Boyd; president, Robert W. Gillispie; vice-president and general manager, John L. Connors; vice-president, J. S. Boyd; works manager, R. E. Boyd; secretary, J. X. Farrar; treasurer, H. Supp, Jr. Frank W. Faber, who had been secretary and treasurer for more than fifteen years, has resigned to engage in other activities.

Costs and Contracts

E. N.-R. Index Numbers

Cost			Volume		
Mar. 1,	**1930**	**206.80**	**February,**	**1930**	**204**
Feb. 1,	1930	206.46	January,	1930	199
Mar. 1,	1929	207.78	February,	1929	378
Average,	1929	207.02	Average,	1929	317
Average,	1928	206.78	Average,	1928	287
1913.....		100.00	1913.....		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of March 20, with some comparisons, total as follows:

(In Thousands of Dollars)

	Mar. 20, 1930	Average Preceding Four Weeks 1930	1929
Buildings:			
Industrial.....	$11,656	$6,818	$6,476
Other	33,273	31,788	60,414
Streets and roads.	19,076	7,585	3,786
Other eng. constr.	117,881*	15,355	28,739
Total.....	$181,886*	$61,546	$99,415
Total, all classes, Jan. 1 to March 20:			
1930.....			$729,919
1929.....			1,056,194

*Contains Telephone Ext. contr., $106,000,000

New Publications

Water Supply—WALLACE & TIERNAN CO., INC., Newark, N. J., has available for distribution two reprints: "Solution Feed vs. Direct Feed Chlorination," by Marshall Wellington, and the final report of the committee on cross-connections of the New England Water Works Association.

Airport Drainage—A 20-p. booklet has been published by the ARMCO CULVERT MANUFACTURERS ASSOCIATION, Middletown, Ohio, outlining the benefits of drainage for modern airports, giving tabular data and suggestions for the design of drainage systems and showing how the requirements of an airport drainage system are met by Armco perforated pipes. The bulletin is numbered C-2, and is entitled "Building Safety Into Airports—With Efficient Drainage Construction."

Concrete Chuting Plants—Bulletin 304 of the RANSOME CONCRETE MACHINERY CO., Dunellen, N. J., gives details as to the design, construction and erection of the Ransome heavy-type steel mast, which can be used with any of the three types of concrete chuting plants most commonly used on construction work: the counterweight boom chute plant, the continuous line plant and the bin plant. Specifications of chuting parts are also given.

Testing Machines—Underlying principles and design elements of the hydraulic testing machine, as exemplified in the products of the SOUTHWARK FOUNDRY & MACHINE CO., Philadelphia, Pa., are discussed in the new 62 p. catalog issued by that company. About half of this publication is devoted to a discussion of general principles; the other half to specific machines produced by the company.

Manganese Steel—Descriptions of a new hydraulic dredge and of a modern commercial sand and gravel plant are the subjects treated in two recent bulletins issued by the AMERICAN MANGANESE STEEL CO., Chicago Heights, Ill.

Sewage-Treatment Equipment—Engineering data, diagrammatic drawings and installation photographs of the Straightline screen, the Brunotte sewage screen, the Tark sewage screen for the clarification of municipal and industrial sewage, the Link-Belt mechanical aerator and Straightline collectors for settling tanks, grit chambers and grit washers are contained in a 24-p. book issued by the LINK-BELT CO., Chicago, Ill.

Compressed Air—COMPRESSED AIR SOCIETY, New York City, has issued the fourth edition of its Trade Standards. This 47-p. book, illustrated with line cuts, is obtainable at 50c. per copy. New material in this edition includes discussions of air-compressor testing, installation and operation, suggestions in regard to the use of old boilers or tanks as air receivers and the handling of cooling water, and an illustration of an air-cleaning device.

Sheet Metal—Results of exposure tests conducted by the American Society for Testing Materials upon both copper and non-copper bearing iron and steel sheets are given in a 16-p. illustrated booklet, "The Testimony of Science and Service," published by the AMERICAN SHEET & TIN PLATE CO., Pittsburgh, Pa. Test results obtained at Pittsburgh, Pa., Fort Garrison, Ill., and Annapolis, Md., are summarized in chart form in three colored inserts.

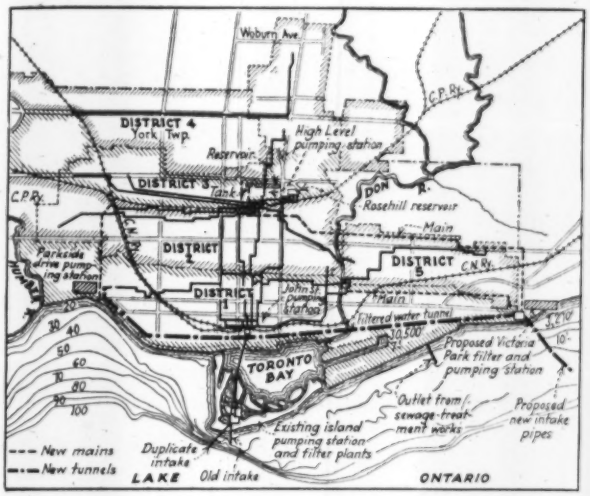
Electrical Conduit—Merits of rigid conduit in providing maximum protection for wiring systems are outlined in a 15-p. illustrated booklet, "Safeguarding Wiring Systems for Buildings," which may be obtained from the rigid conduit section, NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION, Utica, N. Y. The booklet contains a history of the origin and development of rigid conduit, a detailed discussion of its merits and a brief specification to provide for its use in any building.

Welding Pipe—Compiled with the idea of presenting under one cover various facts concerning the welding of steel and wrought-iron piping for modern services, a 77-p. illustrated book, "Arc-Welded Construction for Modern Piping Services," issued by the LINDE AIR PRODUCTS CO., New York City, presents very ably the advantages of the welding process and the reasons for its employment. Of eight chapters, the first three are general in character, the remaining five applying to particular fields of piping construction. The latter include overland lines, high-pressure steam piping, industrial and process piping, welded building and residence piping, and refrigerating installations.

Unit Prices From Current Construction Bids

Toronto's Filtered Water Tunnel

THE first element of the projected duplicate or additional water-supply system for Toronto was placed under contract on bids opened Dec. 17, 1929. This is a 5-mile filtered water tunnel, to extend the length of the waterfront (see map). It comprises a 10-ft. intake tunnel 3,270 ft. long from an intake to a combined high- and low-lift pumping station in Victoria Park, a 7-ft. tunnel 30,500 ft. long to John St. high-lift station, and a 6-ft. tunnel, 18,700 ft. long to the new high-lift pumping station at Parkside Drive, to deliver water from either old or new intake.



TORONTO'S PROPOSED WATER-SUPPLY SYSTEM

The accompanying unit prices are per linear foot and cover 6¼-, 7-, 7¼-, 10- and 11-ft. sections in shale, both concrete lined and gunite lined. Four contractors submitted bids. The Rayner Construction Co., Commerce and Transportation Bldg., Toronto, was awarded the contract for $3,823,218.08, or 26 per cent below the average, for 10-, 7- and 6-ft. concrete-lined.

The same contractor was lowest on the two alternates: (1) 10-, 7- and 6-ft. dia., and (2) 11-, 7¼- and 6¼-ft., both gunite lined. The average bids on these were $5,475,000 and $5,695,000, respectively, compared with $5,199,000 for the accepted 10-, 7- and 6-ft. concrete-lined tunnel.

Engineers are: R. C. Harris, city engineer; Gore, Nasmith & Storrie, Toronto, and H. G. Acres, Niagara Falls.

PRICES PER LINEAR FOOT

	A	B	C	D
3,270 ft.				
10-ft. conc.-lined	$92 23*	$123 19	$130 00	$164 50
10-ft. gunite	109 33	.....	124 75	161 00
11-ft. gunite	118 97	.....	127 00	167 50
30,983 ft.				
7-ft. conc.-lined	72 06*	88 08	110 00	128 80
7-ft. gunite	83 63	.....	108 50	126 30
7¼-ft. gunite	94 00	.....	109 00	129 30
18,700 ft.				
6-ft. conc.-lined	68 93*	81 64	94 00	117 50
6-ft. gunite	75 58	.....	91 00	115 00
6¼-ft. gunite	81 56	.....	92 50	116 75
Pressure grouting, per bag cement	1 25	2 20	2 25	2 50
10-, 7-, 6-ft. conc.-lined	$3,823,218 08	$4,658,481 94	$5,591,030 00	$6,725,775 40
10-, 7-, 6-ft. gunite	4,361,963 39	.....	5,471,288 00	6,590,122 90
11-, 7¼-, 6¼-ft. gunite	4,826,605 90	.....	5,522,187 00	6,737,051 90

*Contract prices.

Average of Lowest Two Bidders on Twelve Massachusetts State Highway Jobs

ON NOV. 19, Dec. 3 and 17 and Jan. 7, bids were opened by the Massachusetts Department of Public Works on twelve highway projects. The lowest bids total $1,575,000, or 4 per cent under the second bids. The accompanying tabulation lists the average bids for the common items submitted by the lowest two bidders on each job. The figures in parentheses are quantities in thousand units. The last column gives the weighted general average.

Following are the jobs and the lowest two bids that were received on each:

I—Reconstructing state highway in Ewing: $152,315.60 and $159,196.25; II—in Ipswich, Rowley, Newbury and Newburyport: $344,802.05 and $374,395.30; III—in Orange: $119,429.85 and $121,813.25; IV—in Gardner and Templeton: $153,596 and $156,848; V—in Marion: $168,919.50 and $180,554.50; VI—in Lynn: $49,919 and $51,412.50; VII—in Reading and Stoneham: $136,844.10 and $140,264.50; VIII—in Hingham and Weymouth: $96,429.90 and $100,312.50; IX—in Natick and Wellesley: $132,626.80 and $133,036.20; X—in Barre: $53,099.15 and $53,469.95; XI—in Natick: $106,299.40 and $107,952.20; XII—in Hadley: $60,608.40 and $65,196.80; XIII—weighted general average.

	I	II	III	IV	V
A—Roadway earth excavation., cu.yd.	(30) $0 57	(38) $0 43	(19) $0 63	(25) $0 55	(24) $0 52
B—Bridge excavation., cu.yd.		(0 23) 6 00	(0 18) 4 50	(0 17) 2 25	
C—Ledge excavation, cu.yd.	(10 5) 2 38	(10 4) 2 42	(2 8) 1 87	(0 70) 2 75	(0 1) 3 00
D—Borrow, cu.yd.		(20) 0 60	(0 70) 0 50		
E—Plain concrete masonry, cu.yd	(0 23) 19 00	(0 20) 20 00	(0 09) 21 00	(0 09) 18 50	(0 10) 23 00
F—Reinforced-concrete masonry, cu.yd.	(0 03) 25 00	(0 39) 32 80	(0 15) 32 50	(0 03) 24 00	..
G—Cement concrete surfacing, cu.yd.		(12) 9 12			
H—Broken stone, tons	(19 3) 2 78	(0 82) 2 55	(15 2) 3 02	(21) 3 00	(32) 2 80
I—Bituminous material, gal.	(126 5) 0 10	(67) 0 09	(107 8) 0 10	(173 8) 0 10	(229) 0 09
J—Fencing, lin.ft.		(0 53) 0 60	(0 05) 0 47		
K—Stone filling, cu.yd.	(0 2) 2 18		(0 13) 2 50	(7 7) 2 38	
L—Riprap, cu.yd.		(0 24) 4 50	(0 27) 3 00	(0 03) 3 25	(0 03) 3 50
M—Gravel borrow, cu.yd.	(20) 0 70	(44) 0 82	(9 7) 0 70	(16) 0 73	(22) 0 75
N—Sand borrow, cu.yd.	(1 5) 1 25	(0 55) 1 75	(1 0) 1 38	(1 4) 0 85	(2 2) 1 45
O—Stripping gravel pits, cu.yd.	(2) 0 20	(4) 0 20	(0 96) 0 20	(1 7) 0 20	(2 3) 0 20

	VI	VII	VIII	IX	X	XI	XII	XIII
A	(6) $0 52	(12) $0 45	(16) 10 53	(15) $0 45	(5) $0 57	(7) $0 70	(6) $0 58	(203) $0 525
B			(0 4) 3 75		(0 17) 2 25	(0 17) 4 00		(1 32) 3 89
C	(0 6) 1 95	(2 9) 2 57	(2) 1 57	(1 6) 2 50	(0 01) 3 00	(1 1) 2 70	(0 01) 3 50	(32 72) 2 335
D	(0 1) 0 75				(4) 0 52			(24 8) 0 584
E	(0 01) 16 50	(0 01) 15 00	(0 03) 22 50	(0 01) 19 00	(0 06) 17 25	(0 02) 22 50	(0 03) 25 00	(0 88) 20 045
F		(0 10) 19 00	(0 24) 24 50		(0 07) 24 50			(1 01) 28 348
G		(5 7) 9 00		(6 2) 9 00		(5 3) 9 12		(29 2) 9 071
H	(14) 2 02	(10) 2 12	(17) 2 20	(9 1) 2 60	(7 5) 2 98	(8) 2 08	(11) 2 15	(164 92) 2 591
I	(105) 0 08	(92) 0 09	(113) 0 09	(75) 0 09	(65) 0 10	(60) 0 09	(104) 0 10	(1,317 6) 0 09
J	(0 5) 0 55		(0 01) 0 65			(0 24) 0 58	(0 06) 0 52	(1 99) 0 555
K				(0 06) 2 00	(0 01) 2 17	(0 04) 2 00		(8 14) 2 372
L					(0 03) 2 50		(0 03) 3 00	(0 63) 3 583
M	(5) 0 73	(11) 0 70	(19) 0 77	(11) 0 75	(0 1) 0 78	(8 7) 0 75	(6 5) 0 60	(173) 0 75
N	(9) 1 00	(0 5) 1 38	(1) 1 25	(5) 1 55	(5) 1 12	(5) 1 30	(6) 1 38	(30 05) 1 586
O	(1) 0 20	(1) 0 20	(2) 0 20	(1) 0 20	(0 05) 0 20	(9) 0 20	(7) 0 20	(32 01) 0 20

Unit Prices From Current Construction Bids

Power Equipment for Municipal Plant at Muscatine, Iowa

CONTRACTS were recently awarded, through Burns & McDonnell Engineering Co., Kansas City, for an addition to the Muscatine (Iowa) power plant. The brick and steel building was awarded Nov. 19 to Layton V. Peterson, local, for $24,200; coal slab and hopper to Thomas F. Mayer for $6,970. Following are the specifications and bids on the equipment (opened Dec. 10):

	Boiler A*	B	C	D	E
Type		Bent Tube		Cross-Drum	
Working pressure	250	250	250	250	250
Heating surface, sq.ft.	10,100	10,080	10,230	10,240	9,448
Pressure drop at 200% capacity, lb.	2.8	12	4.4	5.5	7.7
Superheat at 100% rating	120	135	....	100	103
Superheat at 200% rating	155	160	160	150	146
Cost of boiler, superheater and soot blower	$30,346	$25,461	$29,593	$30,000	$30,835

Contract awarded to (A) Murray Iron Works. Other bidders: (B) Lasker Iron Works; (C) Connelly Boiler Co.; (D) Springfield Boiler Co.; (E) Babcock & Wilcox Co.

*Lowest price when considering all factors of specifications.

	Stoker A*	B	C	D
Type		Underfeed		Chain Grate
Grate area, sq.ft.	203	205.7	.....	248
Retorts	10	10	.....	.....
Tuyeres	25	25	.....	.....
Furnace eff. at 200% rating	76.9	76	73–72.5	75.4
Coal per hr. per sq.ft.	40.4	36.2	19.4–36	27.7
Draft fan, hp	16	35	26	23.5
Cost of stoker and draft equip.	$14,300	$15,295	$16,098	$15,200

Bidders were (A) Westinghouse Elec. & Mfg. Co. (awarded contract) (B) American Engineering Co.; (C) Riley Stoker Corp.; (D) Babcock & Wilcox Co.

*Lowest actual price and lowest price per sq.ft. grate area.

Brickwork	A	B	C
Cost (if underfeed stokers)	$5,500	$5,287	$6,050
Cost (if chain grate)	6,000	6,726	6,325

Above three bidders were: (A) Michael Liptack; (B) Rau Construction Co.; (C) D. Connelly Boiler Co. There were several other bidders, among whom was August Blaeswigh (awarded contract), whose bids were per 1,000 brick, as follows; No. 1 fire, $84.30; No. 2 fire, $75.80; common, $29.90.

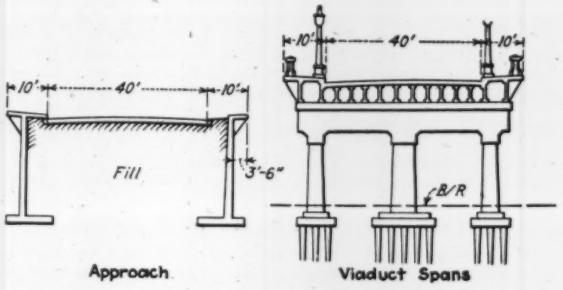
	A	B	C
Coal handling, including bunker, elevator, larries, bucket	$11,440	$12,000	$16,750
Ash handling, including 30-ton bunker, skip hoist	11,400	15,394	20,030

Coal handling: Neither A, B nor C received contract, which went to Stephens Adamson Manufacturing Co. for $7,665 exclusive of bucket.
Ash handling: Contract to C, Stephens-Adamson Mfg. Co.

Grade-Separation Viaduct at Akron, Ohio

THE East Thornton St. viaduct over the tracks of the Baltimore & Ohio, Pennsylvania and Erie railroads in Akron is the third such structure to be awarded under the grade-separation program of that city. Thirteen bids were received (Jan. 27, 1930). The lowest two were rejected because of technical irregularities. The third bid and the lowest regular estimate was by the McCourt Construction Co., which was awarded contract with the approval of the engineers of the three railroads: W. D. Wiggins (Pennsylvania); H. A. Lane (B. & O.); G. S. Fanning (Erie).

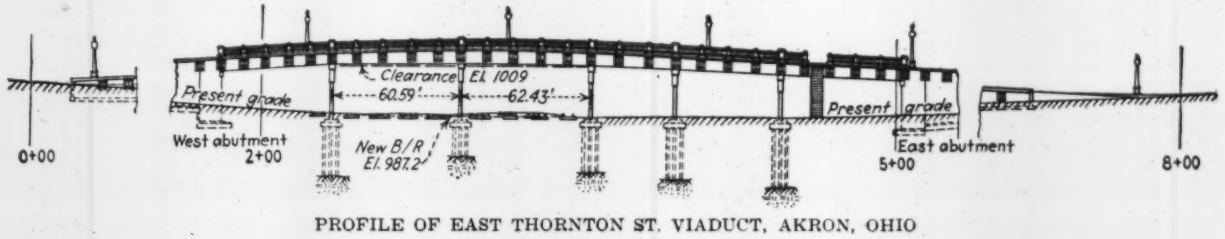
East Thornton St. is 40 ft. wide, but the viaduct will be 60 ft., as shown in the cross-sections. The city is acquiring a 10-ft. strip of land at each side of the present right-of-way. The viaduct will be of steel stringer construction with concrete substructure and deck; the approaches are fill retained by cantilever-type reinforced-concrete retaining walls.



TYPICAL SECTIONS OF VIADUCT AND APPROACHES

Work will be started early this spring and will be finished this year. E. A. Kemmler is highway engineer for the city. Following are the most important items taken from the lowest two regular bids. (A) McCourt Construction Co., awarded contract; (B) Lowensohn Construction Co. Engineer's estimate was $227,083.40.

Item	Quantity	A Unit	A Amount	B Unit	B Amount
Excavation, cu.yd.	2,700	2.00	5,400.00	1.55	4,185.00
Concrete piles precast, lin.ft.	4,000	3.00	12,000.00	2.85	11,400.00
Concrete piles cast in place, lin.ft.	4,000	2.50	10,000.00	2.85	11,400.00
Reinforcing steel, lb	296,600	.045	13,347.00	.04	11,864.00
Copper expansion joint, lb.	1,130	1.20	1,356.00	.95	1,073.50
Class B conc. limestone agg., cu.yd.	2,650	22.00	58,300.00	20.60	54,590.00
Class B gravel agg., cu.yd.	2,650	21.50	56,975.00	20.00	53,000.00
Class B slag agg., cu.yd.	2,650	21.70	57,505.00	20.00	53,000.00
Structural steel, lb.	900,000	0.045	40,500.00	0.044	39,600.00
Iron castings, lb.	66,820	0.065	4,343.30	0.08	5,345.60
Galv. iron pipe railing 2", lin.ft.	500	2.20	1,100.00	4.9	2,475.00
Galv. iron pipe railing 1½", lin.ft.	115	2.20	253.00	4.85	557.75
Waterproofing, sq.ft.	13,050	0.15	1,957.50	0.16	2,088.00
Dampproofing "A," sq.ft.	15,600	0.10	1,560.00	0.045	702.00
Dampproofing "B," sq.ft.	15,600	0.05	780.00	0.045	702.00
Gunite 1½" incasing, sq.ft.	58,100	0.38	22,078.00	0.385	22,368.50
Gunite 1" form slab, sq.ft.	10,390	0.35	3,636.50	0.34	3,522.60
Gunite 3" slab, sq.ft.	3,805	0.43	1,636.15	0.435	1,655.18
Gunite 2" facing, sq.ft.	2,700	0.57	1,539.00	0.57	1,539.00
Gunite over blast plates, sq.ft.	1,800	0.43	774.00	0.425	765.00
Laying 12" water main, lin.ft.	800	0.60	480.00	1.00	800.00
1" open diamond mesh, sq.ft.	1,200	0.70	840.00	0.23	276.00
Subway stair treads, each	38	10.00	380.00	15.85	602.30
Grading, cu.yd.	8,500	0.60	5,100.00	0.78	6,630.00
Underdrain 4" pipe, lin.ft.	1,400	0.10	140.00	0.12	168.00
Sandstone curb 6x18" hand dressed, lin.ft.	440	1.40	616.00	1.60	704.00
Sandstone curb 6x16" hand dressed, lin.ft.	645	1.40	903.00	1.50	967.50
Sandstone curb 6x22" hand dressed, lin.ft.	675	1.40	945.00	1.7'	1,147.50
Granite cir. curb 6x18" Class A, lin.ft.	130	2.60	338.00	3.00	390.00
Curb reset, lin.ft.	100	0.60	60.00	0.70	70.00
Concrete base 6" thick, sq.yd.	2,525	1.20	3,030.00	1.6'	4,040.00
Concrete base 7" thick, sq.yd.	2,525	1.40	3,535.00	1.80	4,545.00
Concrete base 8" thick, sq.yd.	2,525	1.60	4,040.00	2.00	5,050.00
Curing concrete base, sq.yd.	2,550	0.02	51.00	0.03	76.50
4" rep. brick pavement asph. filler, sq.yd.	3,955	2.00	7,910.00	2.25	8,898.75
Cement walk—two course 4", sq.ft.	6,400	0.18	1,152.00	0.22	1,408.00
Cement walk—two course 3", sq.ft.	5,310	0.18	955.00	0.18	955.80
Totals			199,766.65		198,561.18



PROFILE OF EAST THORNTON ST. VIADUCT, AKRON, OHIO